

Experiences from the Approval Process of the Wave Dragon Project

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Abstract

This paper presents experiences from the approval phase of the Wave Dragon prototype, deployed in Nissum Bredning in March 2003, and general results from the EU Network on Wave Energy, where information about legal frameworks and experiences from pilot projects in Europe were gathered.

It is concluded that the national legal frameworks relevant for the approval process of wave energy plants have not been fully clarified yet. As this may become a barrier for future development of large-scale wave energy, the approval process of individual pilot plant and prototype projects should be collated and experiences should be exchanged in order to effectively enable future developments. Furthermore project developers should aim at the highest possible level of information in relation to legal authorities as this might facilitate the content procedure of new power producing wave energy devices for the approval of which no previous experiences exist.

Introduction

The objectives of this paper are to present experiences and conclusions of relevance for project developers and authorities, based on the experience gained first and foremost from the approval process of the Wave Dragon project.

During the planning and pre-planning process of wave (and tidal) energy projects, developers are in general confronted with a number of specific rules and regulations.

In general, planning rules and regulation concerning offshore renewable energy projects within and beyond the 12-mile-zone (see below) do not exist in all countries, but can be foreseen in the coming years, especially for offshore wind energy. It may be expected that rules and regulations laid out for offshore wind energy schemes may in many cases also apply to wave energy projects.

Not only are the legal frameworks still under construction and unclear in many countries, but national planning rules may vary significantly within the EU, and even on the national level, different and sometimes confusing legal frameworks exist within individual countries [16].

For example, different regulations regarding the same subject exist in some countries, depending on whether a proposed project is located inside the 12 nautical-mile zone (often referred to as 'territorial sea') or outside ('exclusive economic zone', EEZ, extending from the 12 nautical miles zone seawards to a maximum of 200 nautical miles from the shoreline).

In the British report on 'Future Offshore' it is concluded that current UK legislation (2002) fails to provide a firm basis for development beyond territorial waters and that new legislation is therefore urgently needed [7].

Below, general aspects relevant for the approval process of wave energy projects are briefly pre-

sented. Based on a thematic approach, issues from the approval process of the Wave Dragon project will thereafter be highlighted, as a specific illustration of the subjects, problems and challenges that other developers are likely to meet.

Background - International legal frameworks

Delineation of the sea

The United Nations Convention on the Law of the Sea, UNCLOS, sets out the rights of a coastal state over its territorial sea and over the seas beyond this limit.

The maritime zones of relevance for wave energy, defined by this Convention, are [13] -

- The territorial sea (up to a limit not exceeding 12 nautical miles)
- The contiguous zone (the zone adjacent to the territorial sea up to 24 nautical miles)
- The continental shelf (the sea-bed and subsoil of the submarine areas that extend beyond the territorial sea of a coastal state throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the base-lines)
- The EEZ (the Exclusive Economic Zone is an area beyond and adjacent to the territorial sea, extending up to, but not beyond 200 nautical miles, and includes, besides the sea-bed and subsoil, the waters superjacent to the seabed)
- The high seas (all parts of the sea that are not included in the EEZ or in the territorial sea).

Whilst a coastal state has full sovereignty over its territorial sea, its rights beyond the 12 nautical miles boundary are more limited. A coastal state has sovereign rights for the purpose of exploiting the natural resources of the seabed and subsoil,

such as oil and gas, of its continental shelf. But the production of energy from water, currents and wind will only be possible according to international legislation if the state has established an EEZ around its territory, or a special renewable energy production zone, which the individual coastal state has the right to do, according to the UNCLOS.

In order to protect offshore installations, and to ensure safe navigation, a state may establish safety zones around such installations and structures for a distance of up to 500 m, but still the state must not interfere with international laws, such as the right of freedom of navigation

International conventions and declarations

The following conventions may prove relevant to future wave energy developments:

- ESPOO Convention (on Environmental Impact Assessment in a Transboundary Context [8]). The objective of the convention is to promote international cooperation on Environmental Impact Assessment, especially in a cross-border (transboundary) context: Countries are obliged to assess, at an early stage of planning, the environmental impacts of certain projects with possible cross-border impacts, and to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact on a cross-border level.
The EC SEA Directive will in many cases ensure that the information and consultation requirements of the ESPOO Convention are fulfilled.
- OSPAR (on the Protection of the Marine Environment of the North-East Atlantic [11]). The convention stipulates that contracting parties must take necessary measures to protect the maritime area against the adverse effects of human activities in order to safeguard human health and conserve marine ecosystems.
- Barcelona Convention (on the protection of the marine environment and the coastal region of the Mediterranean [1]). Within this framework an Action Plan, covering e.g. coastal zone management and protection of ecosystems, is serving as the basis for sustainable development in the area.
- Helsinki Convention (on the Protection of the Marine Environment of the Baltic Sea Area [9]). The convention applies to the marine environment of the Baltic Sea and internal waters.
- Bergen Declaration (Fifth North Sea Declaration, March 2002, on the Protection of the North Sea [2]). In this declaration a number of commitments are made, e.g. regarding the development of renewable energy technology, inter alia offshore wind energy, agreeing upon the necessity of and benefits from taking ac-

tion in order to exploit the potential of offshore wind energy fully and safely (while applying the precautionary principle), for instance by encouraging authorities to develop guidance on areas suitable for the development of offshore wind and to exchange information and experience.

In co-operation with the EU, OSPAR was invited to

- develop a set of criteria regarding the decision-making on applications for the development of offshore wind energy installations,
- develop best-practice guides regarding location, construction, operation and removal of offshore wind farms in order to facilitate their development and to protect the marine environment.

When wave energy is deployed in larger scale in the North Sea it is very likely that an identical set of guides and criteria will be developed.

Environment - Protected species and habitats

The following conventions and directives may prove relevant for the development of wave and tidal energy, if the deployment site is located inside the borders or close to a designated area:

- the Ramsar Convention (on wetlands and waterfowl habitat of international importance [12])
- the Bern Convention (on the conservation of European wildlife and natural habitats [3])
- the Bonn Convention (on the conservation of migratory species [5])
- the EC Birds Directive (on the conservation of wild birds [4] – Special Protection Area, SPA, is the official EU term covering areas that deserve protection according to this directive), and
- the EC Habitats Directive (on the conservation of natural habitats and of wild fauna and flora [10] – Special Area of Conservation, SAC, is the term for areas designated consistent with the Habitats Directive).

Designated areas according to these conventions and directives often overlap partially or wholly. If a specific project is expected to have an impact on such areas, an assessment must be carried out either as part of the EIA or as an individual assessment. Possibilities for derogation depend on the proposed projects, its specific size, location and assessed impacts and the specific statements in the conventions and/or directives in question.

National legal frameworks

Experiences from the EU Network on Wave Energy

During the project lifetime of a wave or tidal energy project, the following issues are bound to be considered, in accordance with national rules and regulations:

- Location of project
- Grid connection, sea cables and power production
- Sea lease
- Marking requirements
- Environmental Impact Assessment (EIA)
- Consultation
- Insurance
- Decommissioning

As no firm legal frameworks covering wave and tidal energy currently exist, often the authorities responsible for the permit procedure must create rules, regulations or recommendations specifically for wave energy projects based on existing frameworks from e.g. offshore wind [16].

This may lead to a delay of the specific project and is bound to be an issue of uncertainty, incl. financial uncertainty, for the developer while planning the project.

As the lack of firm legal frameworks may become a barrier for future developments it is important that developers, based on experience from various prototypes, are aware of potential problems and prepared in order to mitigate potential time-consuming obstacles.

These experiences should be incorporated into the legal system, in order to develop new or modify existing planning procedures with the purpose of obtaining a straight-forward, flexible planning and approval process tailored for the development of wave energy. Otherwise legal authorities will start from scratch for every new wave energy technology with the consequence that e.g. fears for environmental problems and risk aversion might prolong implementation.

The Wave Dragon Project

The Wave Dragon prototype is a 20kW offshore wave energy converter of the overtopping type deployed in Nissum Bredning, a large inlet in Denmark (with significant wave heights in scale 1:4.5 of the North Sea).

The Wave Dragon basically consists of two wave reflectors focusing the waves towards a ramp, a reservoir for collecting the overtopping water and a number of hydro turbines for converting the pressure head into power.

Wave Dragon has a total width of 57 metres and a total weight of 237 tonnes. The maximum height above sea level is 4 metres (due to the 20 feet control container on top of the platform) and it is moored via two gravity mooring blocks (fore and aft) placed on the sea bed.

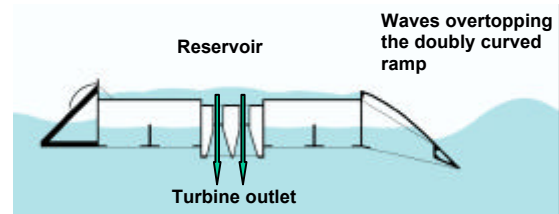


Figure 1, principle of the Wave Dragon

The prototype was deployed in March 2003, and during the following months testing started. Since June 2003 the prototype has been connected to the local distribution network as the world's first offshore wave energy converter.



Figure 2, photo from the first deployment site of Wave Dragon with reflectors, platform and container

The purpose of the 2 years test programme at two different locations in Nissum Bredning is to establish the background for optimising the design of the structure and regulation of the power take-off system [13].

Experiences from the approval phase of the Wave Dragon

Although the Danish Energy Authority proved very flexible during this process of approval, and although a one-stop-shop-procedure¹ as for offshore wind energy projects was pursued, problems and challenges arose during the planning phase.

Especially it proved to be a challenge that the Wave Dragon as a floating offshore power producing unit presents a new technology for the approval of which no official guidelines or administrative experiences exist.

Chronology of applications

Before applications were sent to the relevant authorities, the following actions were taken by the project managers behind the Wave Dragon project:

¹ One-stop-shop procedure indicates that one authority takes the responsibility to "process" an application also covering legislative responsibilities/requirements of other authorities

- The project was presented to the local press
- At a meeting in the local energy centre the project was introduced to the local public
- The inventor presented the project to the Coastal Authorities

Although no previous experience existed, it was obvious that most of the approval issues mentioned above (location of project, sea lease, marking requirements, grid connection, sea cables, power production, EIA, consultation, insurance and decommissioning) would require some sort of dialogue with the relevant authorities.

Initially 4 consents necessary for the Wave Dragon project were identified:

1. Establishment of fixed structure in Danish sea territory – responsible authority: Danish Coastal Authority
2. Establishment of sea cables – responsible authority: Danish Energy Authority
3. Utilisation of the wave energy resources for power production - responsible authority: Danish Energy Authority
4. Connection to the local distribution network: Local network operator.

May 2002 the first application was sent to the Coastal Authorities with the purpose of obtaining a permit for the establishment of a structure moored for a longer period. This permit was seen as a precondition for further project development as it is given based on the responses received from a wide range of environmental, maritime and archaeological authorities.

The Coastal Authorities immediately started the process of consulting relevant local and national authorities and communities, including:

- Danish Maritime Authority
- The Royal Danish Administration of Navigation and Hydrography
- Danish Environmental Protection Agency
- Municipal and Regional County Councils
- Danish Forest and Nature Agency
- Cultural Heritage Authority
- The Fisheries Inspection

Besides this, SPOK Consult - the project managers of the Wave Dragon project - sent two applications in May and June 2002 to the Danish Energy Authority (DEA) regarding utilisation of wave energy and deployment of sea cable.

Consequently the DEA consulted the same legal bodies that had already been approached by the Coastal Authorities. Shortly after the DEA therefore decided to pursue the one-stop-procedure as for offshore wind farms and to incorporate all consents in one covering all items.

As the process carried out by the Coastal Authorities at this time was almost completed, it was decided to continue this and incorporate their re-

quirements and conditions in the consent from the DEA.

Besides the one-stop-procedure the local distribution network operator was asked for permit regarding connection to the local distribution network. It turned out that no consent was needed, just an agreement with the local power distributor.

Furthermore, it was realised that a permit concerning occupational health was required, as plans developed for the arrangement of the control container onboard the partly manned Wave Dragon. SPOK Consult contacted the Danish Maritime Authority and had them involved at the time of construction start. New conditions were introduced on the subjects of seaworthiness and safety, even after the deployment of the Wave Dragon as described below.

Finally, negotiations about terms for obtaining insurance were initiated. The insurance was not demanded by the legal bodies, but was deemed necessary by the project developers.

Subject	Responsible institution	Time
Use of sea territory	Coastal Authorities	May 2002
Production	Danish Energy Authority	May 2002
Sea cables	Danish Energy Authority	June 2002
Connection to the local distribution network	Local distribution network operator	May 2002
Safety - Occupational health	Danish Maritime Authority	October 2002
Insurance	Insurance company	October 2001

Table I, overview of applications

Approval issues

The Use of Sea Territory Consent Process

The Coastal Authority initiated the hearing of all relevant national and local authorities in just two days. They collated conditions for the consent regarding the following subjects:

- Location of project incl. marking requirements
- Environmental Impact Assessment (EIA)
- Consultation process
- Decommissioning

No serious objections were presented from this enquiry, however a number of issues were considered and conditions expressed:

Location of project:

Fishing: SPOK was requested to initiate a dialogue with the local fishermen. Luckily it turned out that there were no fishing interests in the areas, and thus no negotiations were needed. This would otherwise probably have led to some sort of compensation to the fishermen as is usually the case for offshore wind projects.

Navigation:

Information of the exact position of the deployment sites was requested with the purpose of inserting these positions in sea maps and informing other users of the area. Specific, detailed instructions were furthermore introduced concerning information before, during and after construction work. However these requirements became less restrictive as the true dimensions of the project were known to the authorities.

After another dialogue with the Royal Danish Administration of Navigation and Hydrography they decided that a yellow cross marking of Wave Dragon was sufficient regarding marking requirements. No warning lights were judged necessary because of the remote location on the two test sites in relation to sailing routes and activities. The Administration of Navigation and Hydrography asked the project managers to propose suggestions for exact location of the marking crosses and subsequently accepted the following suggestions

- orange buoy marking of back mooring block
- yellow cross on top of the container and on the mooring block/pile
- voluntary marking of mooring lines and cable duct.



Figure 3, example of marking: Yellow cross on mooring pile and orange buoy at mooring line

Environmental Impact: The authorities were of the opinion that it was not needed to perform an EIA. This was due to the fact that the Wave Dragon prototype was part of a non-permanent R&D project and due to its relatively small size. This was announced to the public in the beginning of November 2002 with a 4 weeks deadline for submission of protests against this decision. No objections were

expressed and therefore it was finally concluded that it was necessary neither to carry out an EIA nor to fulfil the demands for public consultation that would have been part of an EIA process [6], [14].

A regional county, however, wanted a supplementing evaluation of the potential impact on the three diving duck species that had caused the EU Bird Protection Area designation. In September 2002 an evaluation of impacts on feeding possibilities for the three duck species was sent to the authorities, concluding that no serious impacts could be expected and that observations would be carried out during the 3 years test period. After this report the local county accepted the proposed location of the project.

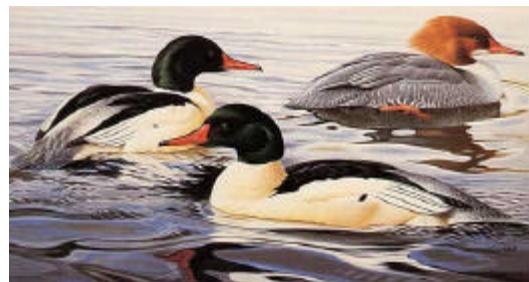


Figure 4, one of the duck species to be protected: Common Merganser

Sea lease: At this time (2002/2003) no sea leases were relevant for offshore renewable projects.

Decommissioning: A 13,500 EUR bank guarantee was required by the Coastal Authority to cover the subject of decommissioning – i.e. to secure removal of the Wave Dragon including mooring blocks and sea cable after the test period.

This relatively modest bank guarantee is based on the assumption that it will not be an expensive process to remove gravity mooring blocks from the sea bed and sea cables just placed on the sea bed. The Wave Dragon itself (platform and reflectors) is expected to be towed away and used by Aalborg University as test facility/laboratory.

The above part of the approval process ended – only apparently, as explained below - in November 2002 when consent from the Coastal Authorities was given.

The Power Production and Sea Cable Consent Process

The nature of this process, where the Danish Energy Authority was the responsible legal body, was not clear from the beginning. The DEA mainly followed the consent procedure for offshore wind farms, thereby perhaps making the process a bit more comprehensive than might have been necessary, as there are some differences between e.g. a 2 MW wind turbine established for at least 20 years

and a 20 kW wave energy converter, deployed for 3 years of R&D.

In January 2003, though, consent for deployment of sea cables was given on the condition that cables without oil should be used. No other requirements were presented, as could otherwise have been expected. As an R&D project with a 3 years lifetime, the subject of cables was treated with much less requirements than is usually the case for offshore projects.

It was no condition that the hydraulic systems should not use oil – the DEA, though, were very satisfied that water is used as hydraulic fluid in all Wave Dragon hydraulic systems.

However, and this almost resulted in a crisis, permission had *not* been granted regarding power production, as the DEA wanted proof that all their conditions had been satisfactorily met. And furthermore a final consent from the maritime authority was required, as the one received in November was judged not to be sufficient by the DEA.

SPOK therefore again had to contact all relevant authorities and local communities in order to receive documentation that the authorities considered all conditions fulfilled. Moreover, it was realised that two legal authorities which should have been consulted much earlier (the HQ Chief of Defence & the Danish Emergency Management Agency), had not been approached. This however did not prove to be a problem.

The process of contacting authorities repeatedly was of course a time-consuming activity, in the period just before launching the Wave Dragon body in the harbour near the workshop where it had been constructed (Aalborg harbour).

In fact, as the invitations to the launching were sent out, this was temporarily seen as a violation of the not-yet-given final consent, but after serious discussions and negotiations with the DEA it was accepted that the launch was not to be regarded as a deployment, and the subsequent launch in March 2003 was therefore not seen as a violation.

Later the same type of discussions arose, as the DEA considered the installation of anchor blocks as a violation of the production consent that had still not been obtained. Again the DEA proved its flexibility and allowed the project development to proceed with no further delays.

Connection to Local Distribution Network

Based on specifications of rated power and connection voltage, the local distribution company established a point of connection with charges based on list prices. The reason for this very simple process can be found in the fact this local distribution network operator has extensive experience concerning integration of wind turbines. In the local area 157% (*sic!*) of electricity consumption is covered by wind power. The price that the Wave Dragon receives for the power production is app. 0.04 EUR/kWh.

The Seaworthiness and Safety Consent Process

As it was realised that a permit regarding occupational health was needed, because the plant including the control container would be used on a regular basis by scientific and technical staff, the Danish Maritime Authority (DMA) was contacted by SPOK.

DMA is the legal authority in relation to occupational health and safety at sea, but as there was obviously no experience with rules for partly-manned wave energy devices, new recommendations and regulations were considered. Existing regulations for offshore fish farms off Faeroe Islands proved capable for serving as a basis.

After careful inspections and evaluation, requirements concerning security were stated. This process involved the following issues:

- Seaworthiness
 - evaluation of stability
 - evaluation of strength of the construction of the Wave Dragon structure
 - quality inspection of construction
- Security
 - installation of life boat
 - life buoys with lights
 - fire extinguishers
 - isolating (power) mats in container
 - sanitation facilities
 - installation of steps to enable man overboard to climb onboard again



Figure 5, DMA went through all details as they usually do when inspecting ships. A bulkhead stiffener had to be changed in order to have more smooth stresses. Furthermore, additional requirements regarding implementation of safety instructions were given.

Insurance

Due to the effects of September 11th it had been very difficult to obtain insurance - several companies had previously refused to insure Wave Dragon (as well as several other offshore projects).

The insurance was finally obtained from the company *IF* in March 2003, a few weeks before the deployment at the first test site.

IF evaluated the stability of the construction, both by inspections and by studying the stability and survivability reports previously issued by Armstrong Technology Ass. (UK Naval Architects) and Aalborg University. The only demands for obtaining a relatively favourable insurance (covering third party liability and a general all-risk insurance) were the establishment of a CO₂ fire extinguishing device in the control container, sealing of the container in order to protect the electronic equipment against sea water and a log book to be updated once a week regarding mooring system.

End of Process

When the Wave Dragon produced power to the local distribution network at the end of June, it not only marked the beginning of a hopefully new era for offshore wave energy converters, but also marked the end of the approval phase that had lasted more than a year.

Compared to other renewable projects, for instance offshore wind, this cannot be a surprise, but for a R&D project with a relatively narrow economic budget and time frame the process was sometimes challenging and certainly an experience to learn from.

Challenges and lessons learned from the approval process of Wave Dragon

It was obviously a challenge during the whole process that the legal authorities had no earlier experience with this type of project and therefore based their content procedures on various strategies. Furthermore, it was difficult to follow a one-stop-shop procedure and the responsibility for the whole procedure changed during the process.

This resulted in a sort of incompatibility between the consent process of the Coastal Authorities and the Energy Authority; the Coastal Authority handled the consent process as a dialogue that continued after deployment of the Wave Dragon. But the Energy Authority wanted all conditions met prior to the time when consent for deployment was given.

Reflecting the whole process, some misunderstandings could quite easily have been mitigated, if for instance the Energy Authority had been presented to the project in details at a meeting, and not just from applications and other written information.

The presentation of the project at meeting between the inventor and the Coastal Authorities before the application process was initiated proved very helpful in this respect.

Detailed information about concept and timescale presented to the authorities at an early stage of the planning process is very beneficial in relation to the subsequent content processes.

Conclusions

Regarding national planning rules and regulations it can be concluded that the legal frameworks have

not been fully clarified yet, which may become a barrier for future development of large-scale wave energy.

Therefore it is important that developers, based on experience from various prototypes, are aware of potential problems and prepared in order to mitigate potential time-consuming obstacles. These experiences should be incorporated into the legal system, in order to develop new or modify existing planning procedures, with the purpose of obtaining a straight-forward, flexible planning and approval process tailored for the development of wave energy. Otherwise legal authorities will start from scratch for every new wave energy technology, with the consequence that fears for environmental problems and risk aversion might prolong implementation.

Experiences from the Wave Dragon project show the importance of thorough information – when introducing a new concept for energy production the developers should give it highest priority to present the best possible information to all legal authorities involved in the process.

A dialogue – face to face – should therefore be initiated at the earliest possible time during the planning or preplanning phase.

Furthermore, developers should remember to allocate a considerable amount of man-hours in the budget to the approval process, and take the time factor into account when scheduling the project in details. Otherwise a serious risk of delay may be difficult to avoid, often with huge financial consequences as the costs offshore and near-shore are much larger than onshore.

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- ESBI Engineering Ltd (UK)
- Kössler Ges.m.b.h. (A)
- Löwenmark F.R.I (DK)
- MT Højgaard AS/Promecon (DK)
- NIRAS AS (DK)
- Nöhrind Ltd (UK)
- SPOK ApS (DK)
- Technical University Munich (GE)
- VeteranKraft AB (SE)
- Aalborg University (DK)

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- the Danish Folkecenter for Renewable Energy where the Wave Energy Test Station is located.

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