Environmental Effects and the Permitting Processes for a Deep Water Offshore Wind-Wave Hybrid Generator

Gabrielle DeVault
Department of Mechanical Engineering
University of Washington

MSME Project Report

March 15, 2011

In order to make advancements in marine renewable energy technology, devices need to be tested and the effects need to be assessed. Unfortunately it is currently very difficult, expensive and time consuming to place a device in the sea to accomplish this. One of the most restrictive aspects of marine renewable energy development is obtaining a license. In order to obtain a license the environmental concerns specific to the project must be addressed. By defining the major environmental concerns and creating a permitting process before seeking a license, it is possible to reduce the difficulty, time and expense involved in installing renewable energy technology in the sea.

Table of Contents

Introduction

Principle Power Inc. is seeking to construct an offshore wind/wave farm that has 30 of its WindWaveFloat electrical generators. The WindWaveFloat device is a semi-submersible platform that is stabilized by ballasted columns. The platform is made of three columns, which can support a wind turbine as large as 5MW rating. Additionally, columns and structural components will host wave energy conversion devices. The wave conversion devices will include two oscillating water columns. The other wave energy device is yet to be decided.

The proposed project location is nine miles off the Oregon coast. This puts the project on the Outer Continental Shelf (OCS) which is typically defined as greater than three miles from the coast. The project is located off the coast of Netarts in Tillamook County, Oregon. The water at that location is between 80 and 150 meters deep.

This project will be challenging to install in the sea, but once it becomes operational is likely to be an important milestone in the renewable energy industry. The challenges are environmental and involve permitting. The environmental concerns must be thoroughly defined in order to satisfy regulatory guidelines. These concerns range from birds colliding with turbine blades and whales encountering the anchor chains to devices leaking chemicals into the ocean. Visual obstruction of the horizon should be small because of its 9 miles distance from the shore. Significant and costly environmental studies are likely to be required before the permitting is obtained. Permitting issues revolve around the need for approval from two separate federal agencies. The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) holds the responsibility for granting a lease on the OCS for the project as well as for permitting construction of the wind portion of the project. The Federal Energy Regulatory Commission (FERC) holds responsibility for permitting construction of the wave portion of the project. All three of these permissions must be granted before construction of the project begins.

Because of the regulatory restrictions it is vital to assess the known environmental information as well as the permitting processes that need to be followed. It is important to do this before unnecessary time and money are spent conducting environmental studies that may have already been done or beginning a permitting process that is not effective. In the case of the WindWaveFloat system, a “smart from the start” approach is even more important because of the groundbreaking nature of the project.

The following pages give a summary of information regarding known environmental concerns and the permitting processes. The environmental section includes the findings of Danish environmental monitoring on two of its large offshore wind farms as well as other information pertaining to the wave portion of the project and the anchor system. The permitting section includes a summary of the BOEMRE and FERC permitting processes as well as a potential hybrid permitting process.

Environmental

Background

Principle Power is looking to construct a wind/wave farm nine miles off the coast of Oregon consisting of 30 devices. The water at the chosen location is between 80 and 150 meters deep. Water this deep requires a floating platform with anchors securing it in place. Categories of importance when assessing environmental concerns are endangered species, marine mammals, and birds. Principle Power has identified the following key areas of importance to the state of Oregon:

- Bald eagle (state threatened)
- Dungeness crab (priority species)
- Hard shell subtital clam (priority species)
- Marbled murrelet (state threatened)
- Northern sea otter (state endangered)
- Rockfish-yelloweye (state candidate)
- Palustrine and marine wetland habitat
- Kelp beds
- Harbor seal haulouts

Principle Power has also identified potentially affected marine mammals as gray, humpback, Minke, and killer whales, harbor porpoises, seals, sea lions, and sea otters.

The complete characterization of the risk to these species and any necessary mitigation strategies will be important in constructing the wind/wave farm. Local people are likely to have two viewpoints: "not in my back yard," and concern for the environment and the species that live in it.

In addition to the public opinion of the project, environmental concerns strongly influence the permitting process. Most of the regulations that must be met in the permitting process center on environmental responsibility. Regulations such as the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA) all have the potential to stop a project in its tracks if the environmental risks are judged too high. If the environmental concerns are not properly addressed before the permitting process begins, the project may not reach construction.

In order to characterize the environment factors, extensive studies may be necessary. Existing information can help to identify areas that have already been studied as well as areas that need more work before permitting can begin. The following sections examine the Danish offshore wind experience and other information that applies to this specific project, including areas that need further study.

Danish Wind Studies

Introduction:

One very important source of information is past environmental studies. The book *Danish Offshore Wind – Key Environmental Issues*, published in 2006 by DONG Energy et al., describes the environmental monitoring programs used at two Danish offshore wind farms: Horns Rev and Nysted. The monitoring programs collected data before, during, and after construction at both locations. The monitoring covered infauna, epifauna, vegetation, fish, marine mammals, birds, and socioeconomic effects.

Horns Rev and Nysted wind farms:

Horns Rev has a capacity of 160 MW (80 turbines, 2 MW each) and is located 14 km west of Blavands Huk, Denmark in the North Sea. Horns Rev wind farm was approved February 2001, constructed in 2001 and 2002, and began operation July 2003. The farm is located in water 6.5 m to 13.5 m deep with 30-34% salinity and a sandy seabed. The turbines have a monopile foundation that is 4 m in diameter and driven about 25 m down in the seabed. A 10 m band of scour protection was placed around each monopile. The cable used to connect the farm to shore is about 19 km long, transmits electricity at 150 kV and is buried to 1 m depth.

Nysted has a capacity of 165.6 MW (72 turbines, 2.3 MW each) and is located 10 km south of Nysted, Denmark in the Baltic Sea. Nysted wind farm was approved July 2001, constructed in 2002 and 2003, and began operation December 2003. The farm is located in water 6 m to 9.5 m deep with 9-13% salinity and a sandy seabed. The turbines have a gravity foundation that has a 4.2 m diameter shaft with a 16 m wide base filled with rock. The foundation sits on a 25 m diameter area of scour protection. The 132 kV cable to shore is about 10 km long and is buried to 1 m depth.

Figure 1: Map of Denmark Offshore Wind Farms

Infauna, Epifauna, and Vegetation:

In order to track changes in the benthic communities Van Veen grabs (see figure 2) and SCUBA diver operated hand cores were used to take samples of the sediment and infauna (the organisms that live in the soft sea bottom). SCUBA divers also took samples of common mussels and other fouling organisms, such as barnacle and other crustaceans, at specified sites. Underwater photographs and videos documented the benthic communities. Comparisons were made between the wind farm area and reference areas outside the wind farm. The main effect of the two wind farms was the creation of an artificial reef from both the turbine foundations and the scour protections.

Figure 2: Van Veen grab used to take seabed samples

At Horns Rev, the hard surfaces (i.e. turbine foundations and rocks used for scour protection) became home to many species not previously found in the mainly sandy environment, thereby increasing the species richness. Initially the common mussel had an exceptionally large colonization but was controlled by the presence of the common starfish (a predator). This gave room for other species to thrive as well. The new hard surfaces on the ocean floor provided shelter for native species as well as for the new species. The new habitat may prove to be a sanctuary for currently threatened species. There was, however, a decline in some species (bristle worms, bivalve thick trough shell). No significant patterns were found to indicate a reason for the decline.

At Nysted, less species diversity developed than at Horns Rev because of to the lower salinity. However, within three years the growth was comparable to a nearby natural reef, where before turbine installation there were few organisms due to the sandy seabed. Mussels dominated the new surfaces as is common in the Baltic Sea (because of the lack of predators) along with barnacles and crustaceans. Most native species at Nysted decreased in number while only the newly introduced species increased.

Fish:

The changes in the fish fauna around the wind farms were studied by fishing and hydroacoustic monitoring. Measurements were taken along transects inside and outside the wind farms as well as during the daylight and at night. Due to the difference in salinity at the two sites, different species are present but similar trends were found.

At Horns Rev the most common fish is the sandeel, which is very important to the fishing community. Sandeels also are very sensitive to sediment size and can therefore provide information on the effects of the wind farm on bottom characteristics. The density of sandeels increased inside the wind farm by 300% from 2002 to 2004 showing that the wind farm did not affect the sediment size in a way that could negatively impact the sandeel.

Overall results show that the density of fish inside and outside the wind farm was similar at both sites. The results from transect measurements show that bathymetry and sediment size are more influential on fish density than distance from the farm. This suggests that the presence of the farm per se does not negatively affect fish density. It is possible that as these artificial reefs become more populated more fish will be attracted to the area and there will be a larger effect from the wind farm evident 5-6 years post-construction.

Effects of electromagnetic fields were not proven. The effects were tested by tagging fish caught in fykes (long bag shaped fishing nets held open by hoops) on either side of the cable to see if they resumed course or altered their path to avoid the cable. The results suggest that migration routes across the cable may be impaired but are not blocked. The electromagnetic field was not directly measured but one species (flounder) primarily crossed the cable in calm conditions, that is, when the strength would be low.

Marine Mammals:

The marine mammals that are present in the areas of the wind farms are harbor and grey seals and harbor porpoises. Seals were tagged with satellite transmitters and monitored on land visually from observation towers and with a remote controlled camera system. Studies of porpoises were conducted by visual surveys from ships and acoustic surveys using T-PODs.

The effects on the Rodsand seal sanctuary 4 km from Nysted were of high concern. Results of the surveys showed that there was no significant change in the seals' behavior at the Rodsand sanctuary compared to other seal locations in the Baltic Sea. The number of seals decreased slightly during construction but returned during operation. During construction and operation newborn grey seal pups were observed indicating breeding in Danish waters on a regular basis for the first time in 100 years. This implies that the construction and operation of the farm did not affect the natural environments of the species in the area.

Horns Rev lies in important waters for seals in terms of foraging. The satellite tagging showed no avoidance effect from the wind farm either during construction or operation. Ship surveys confirm this result except on days when pile driving occurred, during which no seals were observed within the wind farm. These surveys also showed that porpoises could be found inside the wind farm area before, during, and after construction. However, the surveys showed a decrease in the number of porpoises inside the wind farm during construction which returned to normal during operation.

At Nysted, based on acoustic data, the number of porpoises decreased both inside and outside the wind farm during construction. The levels outside the wind farm returned two years into operation, but the levels inside remained well below pre-construction levels.

Birds:

Birds were monitored with radar, human observation (towers and aerial surveys), and infra-red surveillance. The main concerns were collisions and displacement for migratory birds and water birds.

Most, but not all, bird flight paths showed an avoidance response. The radar data showed that at Horns Rev and Nysted, of all birds with flight paths headed for the wind farms 71-86% and 91-92%, respectively, avoided entering the farm. These data also showed that birds modified their flight path as far as 2-5 km prior to the wind farm. While this avoidance of the wind farm does add to the overall distance of the birds' migration, it only accounts for a 0.5-0.7% increase in the total distance. Some species of bird were never seen flying between the turbines, whereas others showed no sign of avoidance. There was no evidence of an attraction response to the wind farm although gulls and cormorants were attracted to the foundations as resting areas. Using a stochastic method to predict collision rates for the common eider, it was estimated that 40-50 birds per year on average would collide with a turbine in the farm. This is about 0.05% of the annual eider hunt in Denmark.

Some birds such as divers and scoters showed changes in feeding and resting places after the construction of the wind farms. These species showed almost complete avoidance of the wind farm area post-construction even though they were present in the area pre-construction. Also, long-tailed ducks showed significant decrease in numbers within the wind farm area post-construction. The displacement of these species from a previously occupied habitat suggests that habitat loss may be a significant problem for some species.

Socioeconomic:

Two surveys were conducted, a sociological and an environmental economic study. The sociological study consisted of 1-2 hour interviews of 46 people as well as examination of the way the wind farms were portrayed in the media. The interviews were conducted with people that had shown interest in the project. The environmental economic study was a quantitative questionnaire in which responders were asked to choose between scenarios including cost, distance from shore and arrangement. The environmental economic study involved respondents from both the Horns Rev and Nysted areas as well as from a national sample.

Regarding the existing wind farms, of the 46 people interviewed, only two expressed a negative attitude; from the questionnaire the Horns Rev sample had a more positive opinion than the Nysted sample. Demographically, middle-aged to elderly men were most negative about the existing wind farms. It was found from follow-up interviews that the opinions of the Horns Rev area became more positive after the construction of the wind farm but the Nysted area's opinions did not improve.

In reference to the construction of future wind farms, the environmental economic study showed that when given the choice between a smaller number of larger farms or a larger number of smaller farms, an overwhelming majority (>70%) preferred a smaller number of larger farms. The study also gauged the respondents' willingness to pay to have the farms moved out of sight. The questionnaire had visualizations of what a farm would look like at 8, 12, 18, and 50 km from shore (visible, less visible, significantly less visible, and virtually out of sight). The willingness to pay was rated in Danish krone per household per year. The conversion is currently about 5.40 DKK per USD. Table 1 shows the different

areas' willingness to pay to increase the distance from shore. These results are likely due to the experience of the different areas with offshore wind farms. Horns Rev is located 14 km from land and visible from few residences, whereas Nysted is located 10 km from shore and in view of many properties.

	National	Horns Rev	Nysted
12 km	322	261	666
18 km	707	643	743
50 km	904	591	1223

Table 1: Willingness to pay for increased distance from shore

Conclusions:

The Danish studies provide important information about the effects of wind farms on the marine environment. Although the Danish wind farms are located in water that is much shallower and somewhat closer to shore than the project location Principle Power has chosen, much of the information is useful. The bottom characteristics are unknown at the site off Oregon, but it can be reasonably stated that the anchors for the 30 turbines will comprise a similar area to the foundations for the 72 turbines at Nysted. Depending on the type of benthic organisms at the site, it may be possible for the Oregon wind farm to have similar effects as at Nysted – an increase in biomass and diversity. The marine mammals found in the two areas are very different and therefore the presence and behavior of the marine mammals near the Oregon site should be studied closely before construction to minimize concerns. The avoidance responses shown by most birds at Horns Rev and Nysted is encouraging in that there might be few problems of bird-turbine collision for a smaller farm farther out to sea. Lastly, the location of the farm at nine miles offshore is farther at sea than the Horns Rev wind farm for which there was a relatively positive socioeconomic outlook on the project. These findings lead to a cautiously optimistic outlook regarding the environmental impacts of the project off the Oregon coast.

Additional Information

Introduction:

While the Danish studies are an excellent source of information for the wind turbines and foundations, there are parts of the Principle Power WindWaveFloat that are not addressed by these studies. Information about the effects of wave energy converters, gray whales, and the anchoring system that are not a part of the Danish wind farm are discussed in the following sections.

Wave Devices:

On October 11 and 12, 2007 a group of around 50 marine scientists gathered at Oregon State University's Hatfield Marine Science Center for a scientific workshop. The results of this workshop were published and titled "Ecological Effects of Wave Energy Development in the Pacific Northwest". While for the most part the discussions centered on wave buoys located in shallow water near the shore, some of the results from this workshop can be related to the WindWaveFloat project. The workshop was organized to discuss specific sectors of the environment on the first day (the physical environment, pelagic habitat, benthic habitat, fish and fisheries, marine birds, and marine mammals) and specific aspects of wave energy projects on the second day (were energy absorbing structures, chemical effects, hard structures and lighting, acoustics, electromagnetic effects, and cumulative effects).

Regarding the physical environment, the biggest concern was the reduction in wave energy especially when a large farm is present. It is a concern that changes in wave characteristics could affect bathymetry, beaches, and tide pools. These concerns should be minimal for a farm of 30 WindWaveFloat devices that is nine miles offshore, however, the effect multiple devices could have on the waves reaching the shore should be researched.

The effects on the pelagic habitat (the part of the water column that is not near the seabed) that relate to the WindWaveFloat system are toxins from antifouling coatings and the attraction of fish. It will be important to take into consideration the type of coatings used on the exterior of the device. Coatings can leach toxins over time and become dangerous to many species. The attraction of fish to the structure may be significant. The workshop believed that colonization of structures by fish and predatory species may happen quickly in the near-shore zone. This should be studied for nine miles out to sea, kept in mind as the project progresses, and monitored both near the project and in the surrounding areas to see if the effects are positive or negative.

The benthic habitat focuses on near-shore habitats with high species diversity. While the habitat at the Principle Power project site is likely to be different, the anchors will add some complexity to the sea floor which may cause effects such as artificial reefs that could change the local organisms and possibly provide stepping stones for invasive species. The anchors may also change local currents and sediment movement which is important to some species. It is important to study the conditions before the project is constructed to know whether these effects will be important.

The effects on fish and fisheries are highly dependent on the location of the project. The workshop discussed near-shore ecosystems which is not applicable to the WindWaveFloat project, however, it did point out that fish are sensitive to noise, electromagnetic fields, and chemicals. Also, the

Dungeness crab fishery is very important to the Oregon economy as it is the largest fishery in terms of dollars. The project's effects here need to be researched before construction.

Marine birds will be much more affected by the wind turbine than the wave components of the WindWaveFloat and results from the Danish studies are more relevant. Marine mammals on the other hand, may be affected by noise, electromagnetic fields, and chemicals like fish. The biggest potential threat to marine mammals could be the mooring cables. The large size of the chains needed for the WindWaveFloat could be a benefit because animals are less likely to become entangled in thick chains as opposed to thin ones. Noise could be significant, since oscillating water column wave generators are known to be very noisy.

On the second day of the workshop wave energy was looked at from a different perspective. Instead of looking at the effect on specific areas of the environment, the effects from specific parts of projects were assessed. Many of the same concerns were repeated. The overall theme of the workshop was that there is a large amount of unknown information when looking at effects of wave energy devices on the marine environment.

Whales:

Gray whales are of particular concern in the project area because their migration route goes up and down the western coast of North America. In fact, the entire Eastern North Pacific population (about 20,000 animals) would pass by the project area twice a year. While they have a rank of "Least Concern" for conservation purposes, they are protected under the Marine Mammal Protection Act and if a renewable energy project were to be dangerous to the species it could threaten the entire population.

Gray whales are a large marine mammal that average about 52 feet long and weigh 40 tons. Their migration route extends from the summer feeding grounds in the Bering Sea to the breeding grounds in Baja California. The southbound migration begins between mid October and November and the northbound migration begins between mid February and as late as April. Gray whales feed on benthic crustaceans like shrimp and krill. The whale feeds by rolling on its side and scooping up sediments that it then filters.

The main concerns for the gray whale are entanglement in mooring lines, increased vulnerability to predation, and harm caused by possibly unearthing transmission lines. A 2008 study was conducted about 50 miles south of Netarts, Oregon that generated data on the distribution and behavior of gray whales migrating along the Oregon coast. The data showed that of 460 whales recorded, the average distance from shore was 4.23 miles with a maximum of 10.74 and a minimum of 0.14. Figure 3 shows the location of these sightings. This data suggests that gray whales usually swim closer to shore than the project location. This reduces the chances of problems encountered with the mooring lines. In regard to increased predation, the gray whales' only predator (besides man) is the orca. Orcas have been known to corner prey against objects (such as large ships) - thus, if the project creates a barrier to the gray whale the orca may use it to hunt them. Lastly, the gray whale feeds by scraping the ocean floor in search of food. If the transmission cables are not buried deep enough, it may be possible that a whale could run into a cable while feeding. Unfortunately, it is impossible to know the occurrence of these events before the project is constructed so the only way to know if a problem exists is by monitoring the area before, during and after construction of a demonstration project.

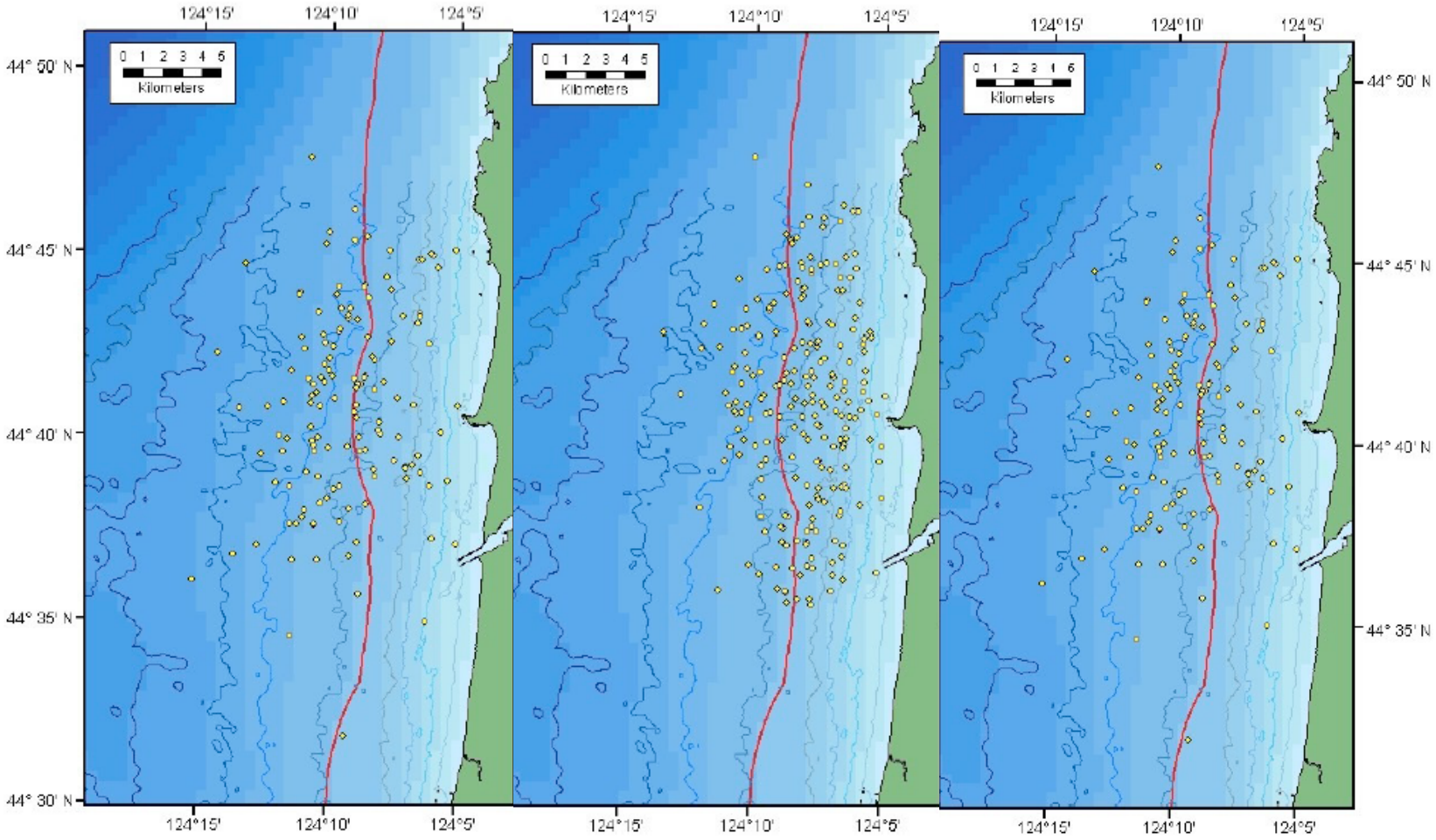

Figure 3: Locations of gray whales during the southbound migration, and two phases of northbound migration

Anchors and Chains:

The last piece of the WindWaveFloat is the mooring system. The WindWaveFloat uses drag embedded anchors connected to the platform by large cables or chains. While there are no deep water renewable energy technologies in existence to learn from, a similar type of anchoring can be found on the Hood Canal Bridge between the Kitsap and Olympic Peninsulas in Washington. The bridge is the longest floating bridge in the world located in a saltwater tidal basin with a span of 7,869 feet. The water depth under the bridge ranges from 24 to 104 meters with tidal swings of 5 meters. There are a total of 46 gravity anchors holding the bridge in place. This averages to about 350 feet between each of the anchor cables with a row of anchors on each side of the bridge. The WindWaveFloat project will have a distance of about 1000 meters between each device. While the cables will not be in a linear pattern as at the Hood Canal Bridge, they will have a larger space between them on average.

There are two main concerns with the mooring system; adverse impacts from anchor installation, and entanglement in the mooring lines. The environmental assessment submitted for the Hood Canal Bridge east half replacement project submitted in May 2002 found no significant impacts from either. It was noted that there would be some temporary impact from the placement of the anchors but the effects would not last after construction ceased.

As for entanglement in the mooring lines, the lines will be large enough that their size will make it very difficult for animals to get caught in them.

Conclusions:

The effects of wave energy devices on the marine environment are unknown. There are many concerns that should be studied before a project is constructed and at the very least monitored. The effects of noise, electromagnetic fields, chemicals, the mooring systems, and the reduction in wave energy, are of concern to the marine environment.

PERMITING

Background

Principle Power is planning to obtain a permit to build and operate the WindWaveFloat system. The proposed location for the 30 devices is off the coast of Oregon on the Outer Continental Shelf (OCS). However, demonstration of a full-scale single device at this site may be the first step. The current jurisdictions give the Federal Energy Regulatory Commission (FERC) authority to grant a license for the wave component of the system. The Department of the Interior's (DOI) Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), has the authority to lease the land on the OCS for the entire project and permit construction and operation of the wind portion of the project. The two federal agencies have different (and time intensive) processes for approving a project, which points to the need for a single process to make licensing a hybrid project achievable at acceptable cost.

To date there has been no attempt to license a hybrid project. There have been statements made regarding the matter, however. One very important statement was made in the memorandum of understanding (MOU) between the DOI and FERC dated April 9, 2009:

> "[DOI and FERC] agree to work together to the extent practicable to develop policies and regulations with respect to OCS hydrokinetic projects to carry out the purpose of this MOU. This will include, among others, processes to address hybrid (wind/hydrokinetic) projects and projects that straddle the boundaries between state waters and the OCS."

While this statement does not legally bind the agencies, it does indicate that they have knowledge of the potential conflicts involved with hybrid projects and a willingness to work together to develop a process to address these conflicts.

There have also been statements that acknowledge the need for a change in offshore wind permitting. Concerns were raised at the American Wind Energy Association (AWEA) conference on October 5, 2010, where both the Department of Energy (DOE) and DOI were in attendance. Dr. Henry Kelly, Deputy Assistant Secretary for DOE's Office of Energy Efficiency and Renewable Energy emphasized: "We need innovation in the way we go about permitting and siting and getting these activities up and running." Also, Jacques Beaudry-Losique, Wind and Water Power Program Manager at DOE stated: "We will seek siting and permitting efficiency through collaboration and multi agency coordination, which has already begun." Shortly after the conference, on November 23, 2010, Interior Secretary Ken Salazar announced: "Our 'Smart from the Start' Initiative for Atlantic wind will allow us to identify priority Wind Energy Areas for potential development, improve our coordination with local, state, and federal partners, and accelerate the leasing process." The announcement of an initiative that has as its goal the streamlining of the permitting process and encouraging offshore wind development is a significant step in the right direction.

While there are shortcomings in the current permitting system and no existing way to permit a hybrid device, the willingness to develop streamlined permitting is there. The following pages explain both the current BOEMRE and FERC leasing/licensing processes in detail. These accounts are followed by a proposed way of combining the two processes into a hybrid process.

BOEMRE

Introduction:

BOEMRE issues leases and grants for renewable energy projects on the OCS. There are two types of leases and two types of grants: commercial lease, limited lease, Rights-of-Way grant, and Rights-of-Use and Easement grant. BOEMRE is required to issue all of the above competitively unless it is determined there is no competitive interest. Because Principle Power intends to use the lease for commercial power generation and since it appears unlikely there will be any competitive interest in the intended project location, the following details apply to a non-competitive commercial lease. The regulations defining the process can be found in the Code of Federal Regulations Title 30 Part 285 on the website: ecfr.gpoaccess.gov.

Leasing Process:

Principle Power will not be responding to a BOEMRE issued Request for Interest (RFI) but instead must submit an unsolicited request for a lease. This request must include the area of interest on the OCS, a description of the proposed project, a general schedule of activities, any available environment or resource data, a statement that the project agrees with state and local energy planning objectives, a complete set of qualification documents, and an acquisition fee of $0.25 per acre. The qualification documents should demonstrate technical and financial capability and show that the company is one that is organized under the laws of a state of the United States. Any privileged or confidential information will be withheld from public disclosure.

BOEMRE will then issue public notice of an RFI in the area that the unsolicited request involves. A determination of competitive interest will be made based on the comments received in response to the RFI. The comment period following the RFI is typically 60 days but can vary. BOEMRE will then issue a notice of non-competitive determination. After this notice the lessee must submit the Site Assessment Plan (SAP) within 60 days. The approval of the SAP and the issuance of the lease will occur at the same time. Once the SAP is approved, the site assessment term of the lease will begin. The site assessment term of a lease is 5 years.

> The SAP describes the activities planned to characterize the commercial lease. These activities may include installation of meteorological towers or buoys or technology testing. Physical characterization surveys such as geophysical, geological, and hazard surveys as well as baseline environmental surveys such as biological and archaeological surveys may be conducted in order to prepare the SAP. These studies can be permitted under the U.S. Army Corps of Engineers' (ACOE) Nationwide Permit program and no longer need BOEMRE approval. The data acquired in these surveys must be included in the SAP. The applicant must also prepare a consistency certification to submit with the SAP. See 30 CFR 285.605-618 for the regulations governing the SAP.

It is allowed to submit both the SAP and Construction and Operations Plan (COP) at the same time, which will add efficiency to the process. If the COP is submitted early it must contain sufficient information for BOEMRE to complete the technical and environmental reviews. Otherwise, the COP must be submitted at least 6 months before the end of the site assessment term. Construction of the project

may not begin until the COP has been approved. If a join SAP/COP is submitted and approved, the operations term begins 5 years after it is approved or when fabrication and installation begin, whichever comes first. If the COP is submitted separately, the operations term begins when the COP is approved. The operations term of the lease is 25 years.

> The COP describes construction, operation, and conceptual decommissioning plans for the wind portion of the project. The plans must include those for the project easement for the transmission cable. The plans must cover all proposed activities in the project area including maintenance activities. The COP must include information such as the location and requirements (land, labor, material, energy) of the operation and facilities. See 30 CFR 285.620-638 for the regulations governing the COP.

Both the SAP and COP are required to show that the activities conducted obey all laws and regulations, are safe, do not unreasonably interfere with other uses of the OCS, do not cause undue harm, use the best available and safest technology, use best management practices, and use properly trained personnel. Both plans must comply with the National Environmental Policy Act (NEPA) and the Coastal Zone Management Act (CZMA) in addition to the numerous other regulations found in the "Necessary Federal and State Regulations" section. The NEPA documents (Environmental Assessment – EA or Environmental Impact Statement – EIS) will be prepared by BOEMRE. Which document is prepared and how long the NEPA analysis takes depends on the complexity of the project.

> An EA is a document used to determine if a proposed activity will significantly affect the environment. If there are no such effects, BOEMRE will issue a finding of no significant impact (FONSI) which may include mitigation measures necessary to avoid such impacts. If an EA is used the NEPA analysis is about a 12 month process.
>
> An EIS is prepared if an EA finds significant environmental consequences. The EIS is a more detailed evaluation than the EA. The public and other federal agencies (besides the preparer) may provide input in the preparation process for the EIS. A draft EIS is issued followed by a comment period before a final document is prepared. If an EIS is used the NEPA analysis is about a 24 month process.

After the final NEPA document is issued for both the SAP and COP (or joint SAP/COP) BOEMRE can approve the lessee's plans and the lease is issued with the terms indicated above.

FERC

Introduction:

There are three possible processes for obtaining a hydrokinetic license from the Federal Energy Regulatory Commission. The three possible processes are the Integrated Licensing Process (ILP), Traditional Licensing Process (TLP), and Alternative Licensing Process (ALP). The ILP is the default process used and both the TLP and ALP require pre-approval from FERC. The following detail is for the ILP because this is the default process and it is unknown whether the Commission will approve a request from Principle Power to use either the TLP or ALP. The ILP has two main parts, the pre-filing process and the post-filing process. A flow chart of the process as found on the FERC website is shown in Figure 4 at the end of this section. The regulations defining the process can be found in the Code of Federal Regulations Title 18 Part 5 on the website: ecfr.gpoaccess.gov.

Pre-Filing Process:

The pre-filing process officially begins when the Notice of Intent (NOI) and Pre-Application Document (PAD) are filed. After FERC receives them, it begins a review followed by a public comment period. The comment period allows public stakeholders to file their thoughts on the proposed project. At the conclusion of the comment period, FERC will decide which process will be used and the post-filing process will begin.

> In the NOI the licensee should state its intent to file for an original license. It should also include the name and address of the licensee, the type, location, and installed capacity of the project, as well as a list of names and addresses of all local political subdivisions affected by the project (see 18 CFR 5.5 (b)(8)).
>
> The PAD "makes known all existing engineering, economic, and environmental information relevant to licensing the project that is reasonably available, or can reasonably be obtained with due diligence" as well as conveying the applicant's schedule for completing and filing the application. Specific information on what information should be in the PAD can be found in 18 CFR 5.6. For the ILP, the PAD must include a proposed date and location for the scoping meeting as well. The purpose of the meeting is to initiate scoping and to review and discuss conditions, objectives, and information in order to finalize the pre-filing process plan and schedule.

Prior to filing the application, the applicant is required to consult with relevant agencies and stakeholders regarding project design, impact, reasonable alternatives, and required studies. A list of agencies to be contacted may be requested from the Director of the Office of Energy Projects (see 18 CFR 5.1 (d)).

Sixty days after FERC receives the NOI and PAD, it will issue a notice of commencement (proceeding). The notice will include in it the initiation by FERC of informal consultations under the Endangered Species Act (ESA), Magnuson-Stevens Fishery Conservation and Management Act, and the National Historic Preservation Act (NHPA). These are all defined in the section below: "Necessary Federal and State Regulations."

The notice also includes the date and place of the public scoping meeting and project site visit which will be held within 30 days of the notice. FERC will also publish Scoping Document 1 (SD1) at the same time as the notice. The purpose of this document is to identify the scope of issues to be addressed in the National Environmental Policy Act (NEPA) analysis, the level of analysis required, waterway plans that would be considered in the analysis, and a process plan and schedule. This is the beginning of the NEPA scoping process, which occurs concurrently with the pre-filing consultation. In addition to the consultations named above, the scoping process should include the consultations for the laws and regulations listed in the "Necessary Federal and State Regulations" section that follows.

Sixty days after the notice is issued all involved agencies and tribes must have provided FERC with comments on the PAD and SD1, including information and studies needed. If necessary 45 days later Scoping Document 2 (SD2) should be issued addressing the comments to SD1.

Based on the comments and study requests, the applicant must prepare a proposed study plan to be filed 45 days after the end of the comment period. The study plan should include time for study plan meetings (held within 30 days of the deadline to file the study plan) to discuss and resolve comments and outstanding issues. Stakeholders have 90 days from the time the study plan is filed to comment and work with the applicant to resolve any disputes. After the close of the comment period, the applicant has 30 days to create a revised study plan followed by a shorter 15 day comment period. After this second iteration the Director of the Office of Energy Projects will make a study plan determination.

Agencies and tribes that have authority to provide mandatory conditions based on the Federal Power Act or Clean Water Act can dispute the study plan determination within 20 days. FERC then has 20 days to assemble a panel to resolve the dispute and the applicant has 25 days to file any comments or information regarding the dispute. The panel has 50 days from the notice of study dispute to deliver findings and recommendations to the Director of the Office of Energy Projects, who then has 20 days to issue a written determination.

After a final study plan is approved the applicant should begin with the studies identified. Within one year the applicant must file an initial progress report on the studies conducted. It is possible (but difficult) to obtain approval to modify the study plan based on the results of the initial progress report and study data.

The FERC license application should be filed by the applicant once the studies are nearing completion. The application content depends on the licensing process (TLP, ALP, or ILP) and type of project (whether it has already been built, is yet to be built or is to be modified, and how large of a capacity will be built). In general the application contains general information, an initial statement, and specified exhibits. The specified exhibits required can be found in 18 CFR 5.18, 4.32(a), 4.38(f), 4.41, 4.51,4.61, 16.10, and 16.11.

Post-Filing Process:

After receiving the application, FERC will issue a public tendering notice that contains a preliminary schedule for processing the application. FERC will then decide to accept or reject the application. If there are deficiencies, the applicant will be notified and given time for correction (no more than 90 days).

Once the application is accepted, FERC will issue the Notice of Ready for Environmental Analysis (REA); then a 60 day period for public comment begins and FERC has 45 days (after the first 60) to reply to the comments.

Sixty days after the notice of REA, the applicant must file for Water Quality Certification with the Oregon Department of Environmental Quality (DEQ) and submit proof of request for certification. DEQ assesses the project to ensure that construction, operation, maintenance, and decommissioning of the project will not violate state or federal water quality standards or become a future source of pollution. The DEQ may grant, conditionally grant, or deny certification. DEQ has one year from the time the application is received to reach a decision.

FERC has 180 days to issue the NEPA document, the draft Environmental Assessment (EA) or draft Environmental Impact Statement (EIS). Any comments on the draft EA or EIS must be filed in the time specified in the draft EA or draft EIS notice (30 to 60 days). After the comment period ends and any issues are resolved, the Final EA will be prepared. Finally, the license order (including the terms and conditions for project operation) is issued.

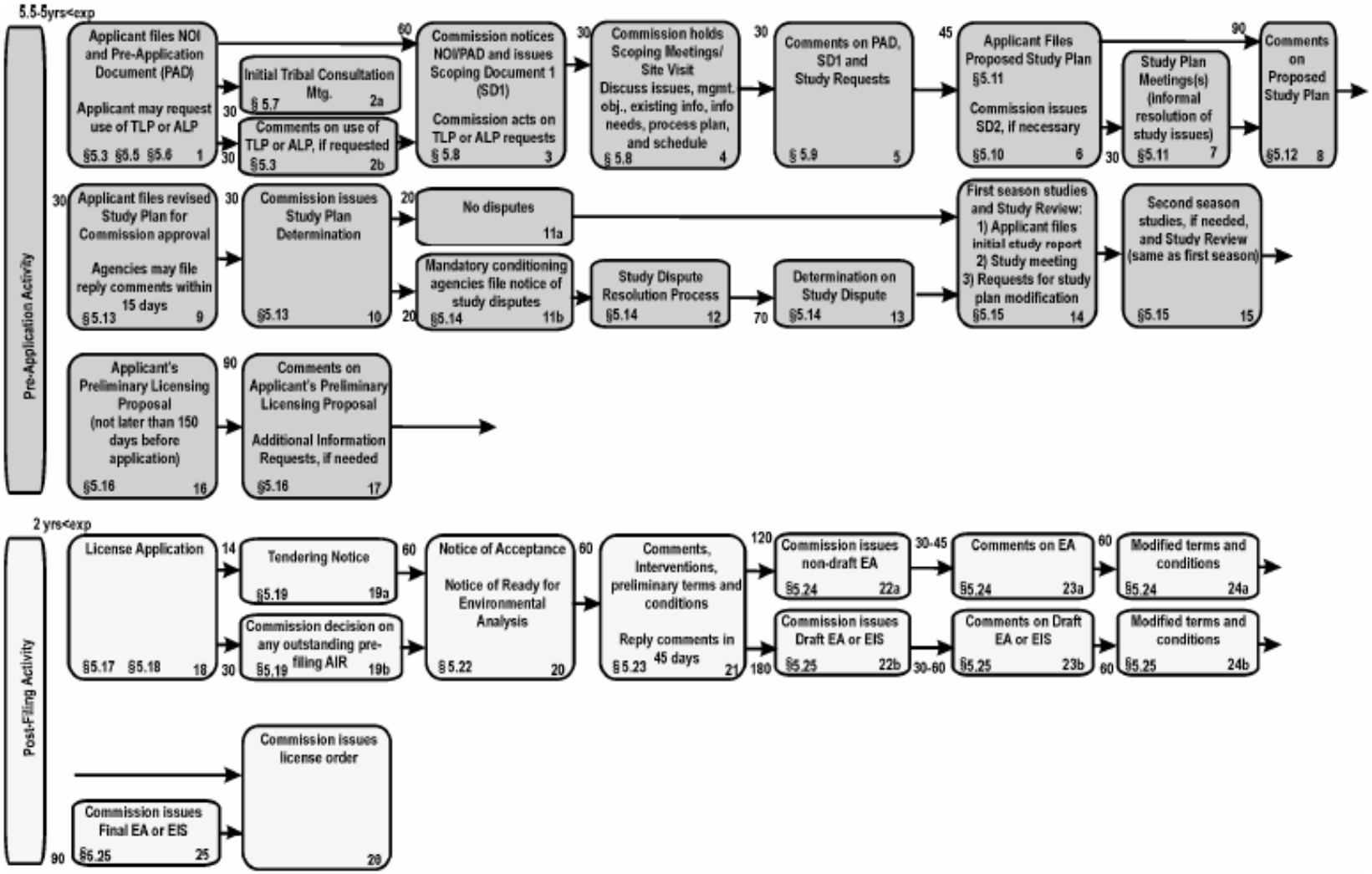

Figure 4: Integrated Licensing Process Flow Chart

Necessary Federal and State Regulations

Federal Regulations:

The NEPA Analysis ensures that federal agencies evaluate potential environmental impacts of the project. This includes effects on natural resources, human environment, and human uses. The NEPA document should include all the information required to satisfy all necessary federal and state consultations.

As part of the ESA Consultation the Services (National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Services (USFWS)) ensure that the project does not jeopardize or result in destruction or adverse impacts to threatened or endangered species (including species habitat). If both FERC and the Services agree that the project will not likely have adverse impacts, the consultation is concluded. Otherwise, a formal consultation must begin.

The Magnuson-Stevens Act ensures that Essential Fish Habitat is protected. NMFS must be consulted on impacts to essential fish habitat, such as changes in temperature, nutrients or salinity of both the water column and underlying surface, and conservation measures. NMFS will provide Conservation Recommendations at the conclusion of the assessment.

In the NHPA §106 Consultation agencies (including FERC) are required to identify and assess the effects of a project on historic resources as well as give the Advisory Council on Historic Preservation an opportunity to comment on the project. They must also consult with all other effected state and tribal offices. There are three stages of consultation: initiation of consultation, assessment of adverse effects, and resolution of adverse effects. All are expected to take 30-60 days to complete.

Migratory Bird Treaty Act Consultation: USFWS encourages applicants to account for migratory bird impacts including collision avoidance, minimization, enhancement, monitoring, and adaptive management for the protection of migratory birds. There is no formal timeline.

Fish and Wildlife Coordination Act Consultation: All federal agencies (including FERC) must consult with the Services and state agencies regarding fish and wildlife. This ensures that construction, maintenance and operation of the project prevent the loss of or damage to fish and wildlife resources.

Marine Mammal Protection Act: NMFS may authorize the project to "harass" small numbers of marine mammals incidentally but not intentionally provided it will not negatively impact the species (Incidental Harassment Authorization, IHA). An IHA requires monitoring and reporting. If there is potential for serious injury or a "take" a Letter of Authorization is needed and will require much more time (up to 2 years). Take is defined as harassing, hunting, capturing, or killing any marine mammal or attempting to do so. Harassment is defined as pursuit, torment or annoyance that has the potential to injure a marine mammal or disrupt its behavior.

River & Harbors Act §10 Review: The Army Corps of Engineers (COE) must authorize any structures or activities obstructing or altering navigable waters. If there are any threatened or endangered species in the area, NMFS and FWS must be consulted by COE before a decision is made. Also, opportunity for public hearings is required.

Clean Water Act §404 Review: COE must authorize dredge and fill activities to conserve and restore waterways. An inter-agency consultation with federal and state agencies will take place. If there are any threatened or endangered species in the area, NMFS and FWS must be consulted by COE before a decision is made. Also, opportunity for public hearings is required.

USCG Review: A Private Aids to Navigation Permit needs to be obtained from the USCG. This is authorization for the owner/operator to properly mark the structure per U.S. navigation standards. COE must approve the §404 and §10 permits before this process begins.

State Regulations:

Coastal Zone Management Act (CZMA) Consistency Review: The Oregon Department of Land Conservation and Development reviews federal activities for a consistency determination, issuing either a concurrence or an objection. Federal actions must be consistent with the Oregon Coastal Management Plan.

Oregon State Removal-Fill Review: The Department of State Lands (DSL) must issue a permit to remove, alter, or fill materials in state waters (likely needed for anchoring and cables). It authorizes short term use and may specify the conditions of use. It usually takes 3-4 months to process.

Oregon State Ocean Shores Review: The Oregon Parks and Recreation Department must authorize a structure to be made or removed on or under the ocean shore (such as maintenance buildings and cables).

Oregon State Special Uses Lease: A Special Uses Lease from the DSL authorizes a use of state-owned land that is not specifically governed by other DSL rules. This will likely be the case for the transmission cable that passes through Oregon state waters. The application must be submitted 180 days before installation.

Potential Hybrid Process

Introduction:

The key to making a hybrid process successful will be planning. Both BOEMRE and FERC (the agencies) will need to be a part of the development process and each agency will have compromises to make. In Figure 5, a timeline of the two separate processes is given. As one can note, both processes have a similar format. The generic form is notification and initial rulings, determination of site evaluation plan, application for license to generate electricity and review, and finally obtaining the license. The proposed hybrid process would combine these parts of the two separate processes. This process is shown in Figure 6, and uses the same assumptions that are found above in this report.

Proposed process:

In the notification and initial rulings part of the process, the applicant would submit a document to the agencies that includes the elements of the unsolicited lease request, notice of intent, and pre-application document. The agencies would then publish a request for competitive interest (to satisfy BOEMRE's obligation to lease competitively) and comments. The notification period would be concluded by the agencies issuing a document that combines the parts of the notice of non-competitive determination, notice of commencement, and scoping document 1.

The second main part of the process is the determination of a site assessment and study plan. This period would start with public meetings and a comment period in response to the scoping document. The purpose of this period is to gain public opinions on what information and studies are needed to characterize the project and project site. After the public has had time to comment, the agencies should issue scoping document 2 and the applicant would submit its site assessment and study plan. Next, the agencies review the applicant's site assessment and study plan. The depth of this review will need to be jointly agreed upon by the agencies. This review should take no longer than one year from submission to approval. After the site assessment and study plan is approved, BOEMRE will issue the lease and the applicant may begin to conduct its studies. The duration of the process is highly dependent on the amount of time that is required to conduct all the studies necessary.

Once the studies are nearing completion (possible 3 to 6 months beforehand) the applicant submits an application for a hybrid lease. This application contains the contents of the BOEMRE construction and operations plan as well as the FERC license application. Once the application is submitted, the agencies would review the application for all the necessary federal and state regulations listed above. The details of this review process would be decided by the agencies in a joint effort and the agreed on process should take no more than two years to complete. Once the hybrid license application is found to be satisfactory, the agencies would issue a license to the applicant with the terms and conditions they find necessary.

Conclusion:

It is possible to create a hybrid permitting process that is achievable for applicants. The process proposed, depending on the time required to conduct necessary studies, could still require 5 years to complete. Further steps to reduce the time should be considered. The key to implementing a process such as this one is agency cooperation. Each agency has its own jurisdictions so it is necessary that they work together in order to develop a process that is legally sound.

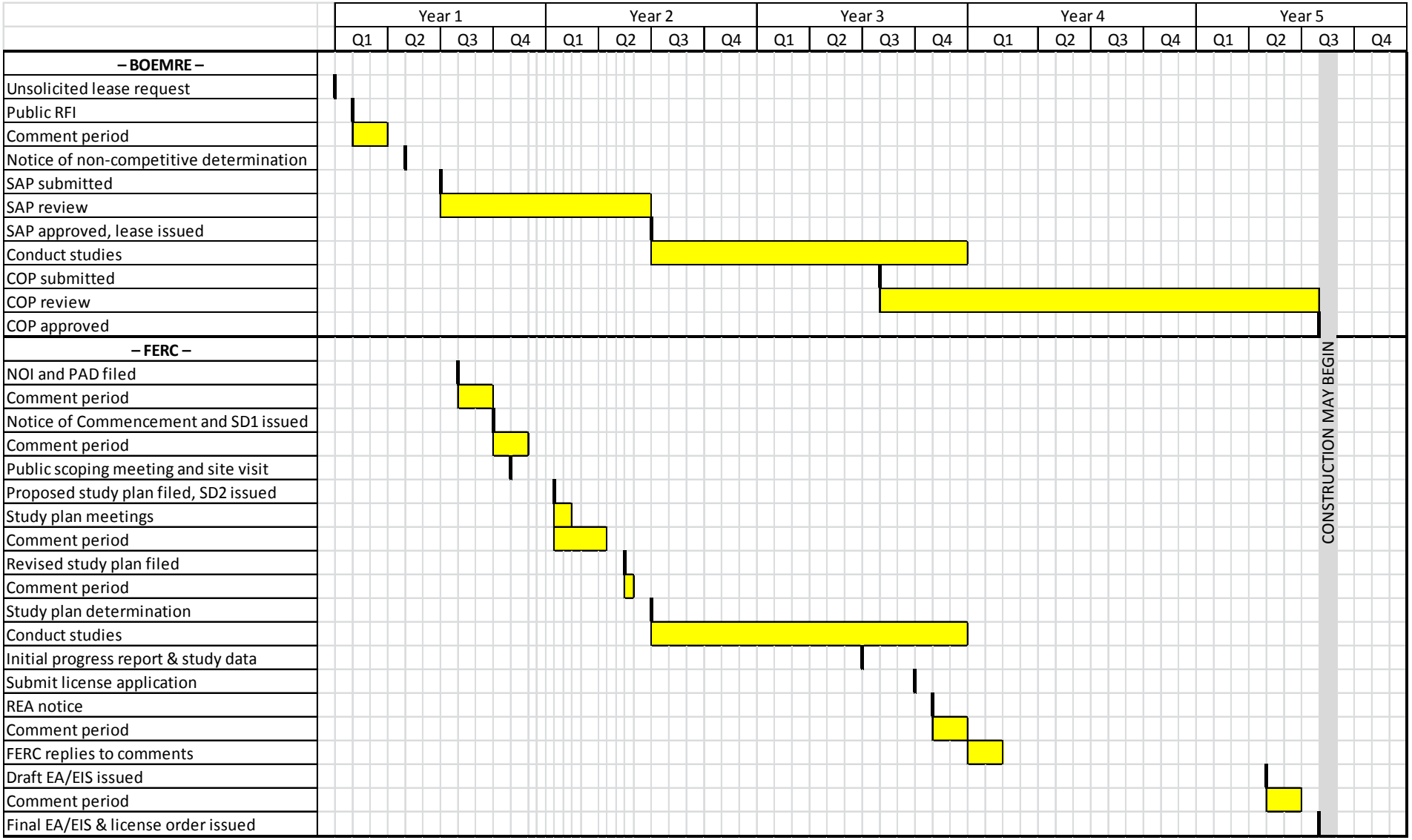

Figure 5: BOEMRE and FERC processes

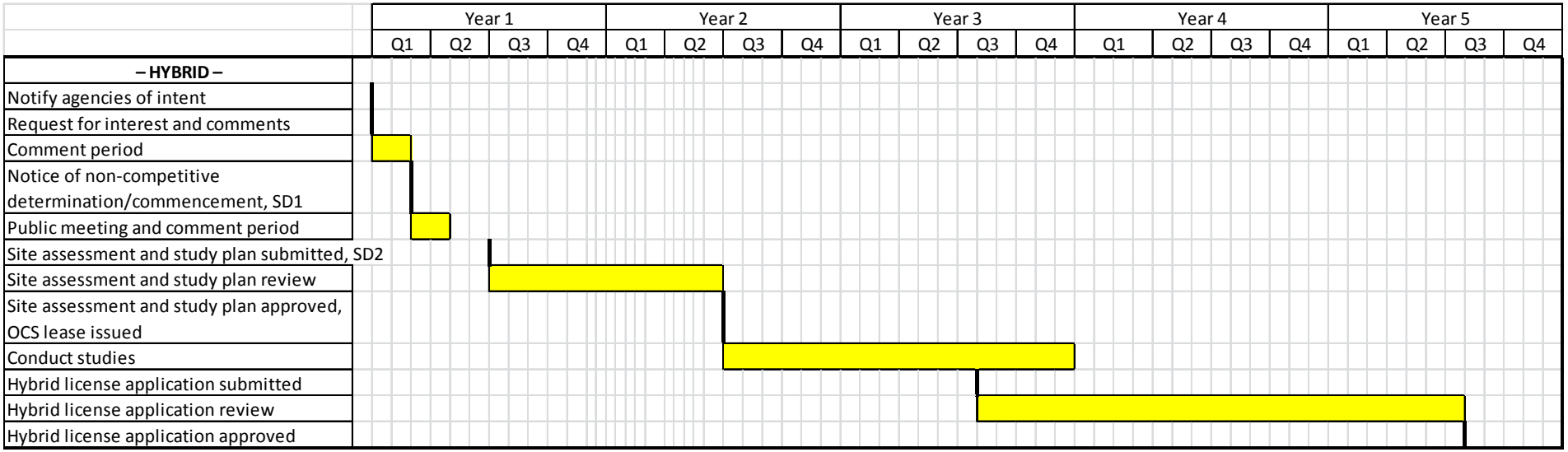

Figure 6: Possible hybrid process

Conclusions and Recommendations

The Danish wind farm studies, the wave energy workshop in Oregon, and a few additional resources give a fairly positive outlook on the environmental impacts from the WindWaveFloat. It is recommended that some studies be conducted before the project is begun. Studies on the production of noise, electromagnetic fields, and chemicals from the device would help to address these concerns. Besides these areas, it is likely that the WindWaveFloat will not have a significant effect on benthic organisms, fish, marine mammals and birds, though studies specific to this site should be conducted. The effect on human populations is likely to be minimal because of the distance from shore, which will put the project nearly out of sight.

Even though it appears that the environmental concerns for the WindWaveFloat project will be manageable, the most important part of the permitting process is preparing a complete environmental assessment. A complete assessment of all environmental factors will speed the permitting process significantly. The fewer the questions and concerns that can be raised by regulators and the public, the more quickly the process will go forward. Because this project is the first of its kind in many aspects, it will be even more crucial to put the effort in at the beginning before permitting begins.

Obtaining licenses for marine renewable energy technologies is difficult enough to begin with, as evidenced by the lack of projects in the water. The project Principle Power is starting will be even more challenging. There are three different permissions that are needed before construction can begin. The first is a lease from BOEMRE. After the lease is obtained, the participant can seek licenses for the wind and wave components of the device from BOEMRE and FERC, respectively. With the best possible scenario, this process could still take five years. If there is need for more than a year and a half of studies or for more in depth regulatory reviews, the overall process will likely take even longer.

One way of making this process more efficient would be to combine the processes with the help of BOEMRE and FERC to make a single hybrid process. Depending on complexity of the project, this could save time and effort and make a license for a wind/wave hybrid achievable. It is most important to be fully prepared with all available environmental information as soon as possible in the process.

References

Proposal for Ocean Energy Project, Principle Power Inc.

Danish Offshore Wind – Key Environmental Issues, DONG Energy et al. 2006. http://193.88.185.141/Graphics/Publikationer/Havvindmoeller/havvindmoellebog_nov_2006_skrm.pdf

Ecological Effects of Wave Energy Development in the Pacific Northwest – A Scientific Workshop, October 11-12, 2007, G. W. Boehlert, G. R. McMurray, and C. E. Tortorici, editors. http://spo.nwr.noaa.gov/tm/Wave%20Energy%20NOAATM92%20for%20web.pdf

Gray whale, Wikipedia. http://en.wikipedia.org/wiki/Gray_whale

Distribution and movement patterns of gray whales off central Oregon: Shore-based observations from Yaquina Head during the 2007/2008 migration, J. G. Ortega-Ortiz and B. R. Mate. http://www.oregonwave.org/wp-content/uploads/Marine-Mammal-Study-OSU-FINAL.pdf

SR – 104 Hood Canal Bridge Project, Washington State Department of Transportation. http://www.wsdot.wa.gov/projects/sr104hoodcanalbridgeeast/

State Route 104 Hood Canal Bridge West Half Retrofit and East Half Replacement Revised Environmental Assessment, Washington State Department of Transportation. http://www.wsdot.wa.gov/NR/rdonlyres/882D0CCD-99E3-4E37-BB34-02F5B89C38DB/0/HoodCanalBridgeEnvironmentalAssessmentMay2002.pdf

Memorandum of Understanding between the U.S. Department of the Interior and Federal Energy Regulatory Commission

Renewable Energy Alternate Uses of Existing Facilities on the Outer Continental Shelf, Code of Federal Regulations Title 30 Part 285. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title30/30cfr285_main_02.tpl

Guidelines for the Minerals Management Service Renewable Energy Framework, U. S. Department of the Interior Mineral Management Service Office of Offshore Alternative Energy Programs. July 2009. http://www.boemre.gov/offshore/renewableenergy/PDFs/REnGuidebook_03August2009_3_.pdf

Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf; Final Rule, Department of the Interior Minerals Management Service. April 29, 2009. http://www.boemre.gov/offshore/renewableenergy/PDF/FinalRenewableEnergyRule.pdf

Recorded Presentations American Wind Energy Association Meeting, BOEMRE. Oct. 5, 2010. http://www.boemre.gov/offshore/RenewableEnergy/AWEPresentations.htm

Integrated License Application Process, Code of Federal Regulations Title 18 Part 5. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=4f97561616ed948d78f5801137aaf70d&rgn=div5&view=text&node=18:1.0.1.2.10&idno=18

Siting Methodologies for Hydrokinetics Navigating the Regulatory Framework, Pacific Energy Ventures. http://www1.eere.energy.gov/windandhydro/pdfs/siting_handbook_2009.pdf

Handbook for Hydroelectric Project Licensing and 5 MW Exemptions From Licensing, FERC. http://www.ferc.gov/industries/hydropower/gen-info/handbooks/licensing_handbook.pdf

Basic Information, National Environmental Policy Act (NEPA), U.S. Environmental Protection Agency. http://www.epa.gov/oecaerth/basics/nepa.html