Offshore Environmental Studies Program

Fiscal Years 2009-2011 Studies Development Plan

Alternative Energy

U.S. Department of the Interior
Minerals Management Service
Alternative Energy and Alternate Use
Herndon, VA
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SECTION 1.0 PROGRAMMATIC OVERVIEW

1.1 Introduction to the Program

Section 388 of the Energy Policy Act of 2005 (EPAct) amended the Outer Continental Shelf Lands Act (OCS Lands Act) to give discretionary authority to Minerals Management Service (MMS) to issue leases, easements or rights-of-way on the OCS for alternative energy projects, such as wind, wave, or ocean current facilities. Under this new authority, the areas that the MMS makes available for alternative energy leasing are likely to be determined through a process that assesses different types of alternative energy resources, anticipated and potential environmental impacts and other relevant information on a national, regional, or local basis. The activities related to the development of alternative energy resources on the OCS would include:

1. Characterization of a specific site or sites on the OCS for the purposes of assessing the feasibility of constructing an alternative energy facility,

2. Construction, operation, and decommissioning of demonstration facilities on the OCS and related environments (i.e., State waters/onshore) for the purposes of testing commercial feasibility of certain technologies, and

3. Construction, operation, and eventual decommissioning of commercial-scale alternative energy production and related facilities on the OCS and related environments.

Developers will likely favor certain geographic areas on the OCS for constructing wind, wave, or ocean current facilities because of the characteristics of the areas favorable for a particular energy source. The anticipated activities are technology testing, site characterization, facility construction, operation, and decommissioning. Prior to approval for any of these activities, MMS will need baseline information about the areas and must make an evaluation of the potential impacts of these activities on the environment.

The MMS has solicited input from the public about the environmental concerns related to this new activity in the marine environment. As part of rulemaking, MMS issued an Advanced Notice of Proposed Rulemaking which included questions to the public about the environment. The MMS also prepared a Programmatic Environmental Impact Statement (EIS), which gathered further input from the public and made an initial evaluation of the potential environmental consequences from offshore alternative energy development. The Final Programmatic EIS was published in November 2007. Concurrently, MMS funded a synthesis report and workshop to identify existing information, primarily from the European experience, and identify information gaps.

To support the scientifically sound evaluation of anticipated activities, the Alternative Energy Program has developed this studies development plan for the Environmental Studies Program (ESP). These studies build on information collected through earlier work and move forward with recommendations from the *Worldwide Synthesis and Analysis of Existing Information*

Regarding Environmental Effects of Alternative Energy Uses on the Outer Continental Shelf (Michel et al., 2007) and the follow on *Workshop to Identify Alternative Environmental Information Needs* (Michel and Burkhard, 2007). The synthesis was reviewed by members of the OCS Scientific Committee and several members attended the Workshop. In addition, MMS cosponsored a workshop in Oregon, *Ecological Effects of Wave Energy Development in the Pacific Northwest* (OSU, 2007), in October of 2007. Recommendations from this workshop are also incorporated.

1.2 Projected OCS Activities

On November 6, 2007, the MMS published a request for nominations from industry for offshore alternative energy resource assessment and technology testing activities on the OCS. The MMS received 43 nominations in response to this request. Most of the nominations received on the Atlantic Coast are for meteorological and oceanographic data collection facilities that would support wind generation projects off Massachusetts, New York, New Jersey, Delaware, Maryland, Virginia, South Carolina, and Georgia. Nominations for areas off Florida focused on ocean current information collection and technology. On the Pacific Coast, the main interest is in wave energy, and nominations were received off California, Oregon and Washington. Regarding Alaska, a single nomination was received for Cook Inlet and relates to tidal power.

The expectation is that in the next few years, offshore activities will focus on evaluation of the resource, such as wind speeds using meteorological towers, and technology testing. The focus of the Environmental Studies Program, in the short term, will be on collecting information for pre-lease needs such as basic characterization of the environment where these activities may occur. Some studies will also focus on foundational information needs, such as creating a database of historical properties that may be impacted by offshore wind development. In the long-term, the potential studies will take advantage of the opportunity to study these technologies during the first stages of development. The information needs will not be site specific but rather focus on a general understanding applicable to a variety of projects.

1.3 Identification of Information Needs

The following sections provide a basic discussion of the existing understanding of information need in the key areas of oceanography, airborne resources, aquatic biology, and social science. This discussion is not meant to be all encompassing but rather provides an initial attempt to define the key information needs of MMS as the development of alternative energy projects on the OCS begins.

1.3.1 Oceanography

Development of offshore ocean renewable energy involves the placing of new types of structures in the ocean. The interactions between these structures and the ocean environment, i.e. wind, currents, waves, etc. is yet to be fully understood. While there are engineering concerns with the impacts of the environment on these new technologies, also of interest is

the potential alteration of ocean processes, both local and regional, by these technologies. The technologies are designed to harvest the energy from the earth's surface with the underlying premise that the amount used is undetectable, however, as more devices are added, there may be an additive effect. As the new technologies evolve, so must our understanding of how these technologies may impact the overall energetics of the ocean environment.

Wind technologies are the most advanced with the most viable design involving the placement of a monopile, with a diameter of 4 to 5 meters, into the seafloor. To be commercially viable, a large number of these devices must be placed in a relatively small area. Presently, one existing wind facility has 80 monopiles, but plans are being made to expand this to 160. Oceanographic processes affected by these devices include wind, waves and currents, and sediment transport both in the near field and far field. In the near field, the wind is affected by the disturbance of the rotors which can create vortexes and eddies. The far field effects are only speculative. The monopiles also interact with the local current and wave regime and may create small alterations in flow, again possibly creating eddies or altering wave patterns. Alteration of waves and currents can also lead to changes in the sediment transport in the area. In the near field, scour can occur around the monopiles, while in the far field, alterations in the longshore transport of sediment may occur. The existing wave regime at proposed sites may determine whether a site can be developed. Because the wind turbines will require regular maintenance, the wave environment must be such that service vessels can reach the turbines.

Wave technologies are still in the design phase and the final design characteristics are unknown. The commonalities between these devices include some sort of floating structure that is tethered to the sea floor by a mooring device. Recent facility designs propose large numbers of these devices in a relatively small area, i.e. 25-50 per square mile. These devices harvest the energy in the oscillating motion of the waves and therefore may have a dampening effect. The extent of this effect is unknown and will depend on the design, the number, and the spacing of the devices. Alteration of wave patterns may also impact sediment transport along the coast.

Ocean current technologies may be, in some ways, very similar to tidal technologies, which involve an underwater turbine that extracts the energy from the current. The turbine is attached to the seafloor by either tethering or a foundation structure. These technologies are still in the testing phase and the final design is unknown. A large number of devices may be placed in a relatively small area and the additive effects of extracting energy from an ocean current are unknown. Scour around the base of these devices is a major concern, since they would be placed in a high energy current regime.

1.3.2 Airborne Resources

In the United States there are more than 200 species of birds that regularly use or travel over the waters of the Federal OCS, therefore, any proposed wind project would potentially impact an avian resource involving a subset of these species. Because of the impracticability to study such vast number of species at once it is useful to divide birds into different groups or guilds

that have similar behaviors while recognizing that these terms are overlapping and their usage varies.

- Seaducks (e.g., eiders, scoters, long-tailed duck)
- Seabirds (e.g., pelagic species such as gannets, petrels, shearwaters)
- Waterbirds (e.g., loons, grebes, cormorants, alcids, gannet, gulls)
- Passerines (e.g., thrushes, warblers, sparrows)
- Raptors (e.g., eagles, hawks, falcons, owls)
- Shorebirds (e.g., piping plovers, red knots, willits, least terns, godwits, curlews)

The evaluation of the impact of a wind project on avian resources requires information about avian resources pre- and post-construction. Potential impacts to birds from offshore wind development involve two major factors: direct collision with wind turbine generators (WTG) or behavioral changes due to the presence of WTGs. Effects of WTGs may include: avoidance of the specific area, barriers to movement (migration, feeding flights), increased energy expenditure, and attraction (feeding and resting sites).

To assess those effects, there is currently a lack of information in key areas. First is knowledge of avian resource (endangered and non-endangered) distribution, movements, and behavior in the specific regions of likely offshore wind energy development. There are currently large gaps in data on the general distribution and abundance, flight patterns (during good weather, nocturnal and inclement weather), and behavior during migration, wintering, foraging, and staging for most avian species that utilize the offshore environment. The second is an understanding of the mechanisms underlying the attraction or avoidance of avian resources to offshore wind facilities.

The current understanding of potential impacts of offshore wind projects on birds is based on the knowledge of the geographic distribution and behavior of certain species, past studies of onshore wind farms, and on environmental studies conducted at existing offshore wind farms overseas.

Avoidance behavior has been documented with seaducks at offshore wind projects in Denmark and Sweden. This occurs when a population of birds that normally would have flown over the preconstruction project area now flies around the developed wind project. The avoidance is triggered by a visual (and possibly auditory) response to the turbines. The significance of such impacts depends on the energetic consequences of the additional flight necessary to circumnavigate wind projects.

Avoidance behavior has also been documented for a variety of waterbird species at European offshore wind projects. This occurs when a population of birds that normally would have fed in the preconstruction project area does not do so after the project is built. The significance of such impacts depends on whether birds can find suitable alternative feeding grounds. Depending on the significance of the impacts from individual projects, accrued impacts from multiple projects have the potential to be significant.

Attraction behavior has been documented for a variety of waterbird species in Europe. The attraction is caused by new food sources (e.g., fish, invertebrates) inhabiting the wind farm area that did not inhabit the area before construction. This new food source is likely generated from increased productivity created by the hard substrate of WTGs in the water column. The attraction also may be caused by perching opportunities offered by the service access platforms of the turbines or other platforms associated with the wind project. The benefit of the new food resource and perching sites potentially increases risk of collision with turbines.

Attraction behavior has also been documented with certain types of artificial lighting that may be used for aviation or navigation obstruction lighting on turbines. It has also been documented with permanent lighting on oil platforms and boats (Michel et al., 2007). In this case, the attraction behavior very likely is caused by a disruption in the physiological senses birds use for navigation at night (Michel et al., 2007). The ensuing disorientation may cause birds to fly in the vicinity of the artificial light for extended periods of time. This results in unproductive energy expenditure and increased risk of collision with wind turbine structures.

The potential magnitude and significance of these impacts may vary greatly between wind project sites. Any specific wind project may have most of the guild groups mentioned above plus specific subgroups or species that raise regional attention. In some areas, endangered species such as the piping plover and roseate tern are a concern.

Interactions between migratory bat species and offshore wind turbines are also unknown. Existing information is based on anecdotal reports of bats observed offshore. Basic information about whether and which bats may be at risk must first be gathered prior to determining whether additional studies are needed.

1.3.3 Aquatic Biology

To help determine areas where information is needed to make environmentally sound decisions about future alternative energy development, MMS contracted for a literature synthesis (Michel et al., 2007). Many of the issues cut across resources such as benthic resources, fishery resources, marine mammals, and sea turtles. The effects of sediment suspension and redistribution and smothering are a concern for benthic organisms in addition to habitat addition, loss, and alteration. Fish and motile benthic organisms may be affected by attraction to and avoidance of facilities by predators and prey. Marine mammals and turtles may be impacted by collisions with vessels or entanglement in cable moorings. Other factors that could result in impacts to marine life include effects of sound, lights, electromagnetic fields, and contaminants. The siting of these facilities is critical to minimizing the impacts and requires an understanding of the locations of sensitive biological habitats through mapping. Evaluations of these potential impacts will be needed in development areas, both regionally and on a site-specific basis.

As new facilities are constructed and decommissioned, sediments in the area will be disturbed by activities such as vessel anchoring, pile driving, cable trenching, and facility removal procedures. A change in the grain size in the immediate vicinity of the activity as the fine components of the sediment are winnowed away can have an effect on the benthic species

assemblage utilizing the area after the activity ceases. A change in the benthic community can affect higher trophic levels due to changes in the prey composition. The suspension of sediment in the water column temporarily alters light availability which can affect primary productivity and the ability of mobile species to find prey and avoid predators. As the sediments settle back to the bottom, benthic species can be smothered.

The introduction of new hard substrate where facilities are placed causes both the loss and addition of habitat. The existing soft sediment substrate is replaced by hard substrate in the form of piles and scour protection for wind facilities, and housings and anchors for wave and current facilities. As mentioned above, the placement of such facilities can alter the existing habitat where grain sizes are changed. The facilities will provide habitat for different communities of pelagic organisms by creating vertical structure in the water column and by making hard substrate available for the attachment of benthic organisms. Waves and currents within an array of structures may be altered, potentially making the area more or less suitable depending on individual species preferences. Addition of structure in an area where none existed previously creates an artificial reef effect. This can also provide stepping stones for the expansion of species ranges, both native and invasive.

Large structures placed in the water have been shown to attract fish. Where the prey is concentrated, predators also will follow. Conversely, an array of structures may be avoided by some species due to noise, electromagnetic fields or the physical obstruction. Where these species are of commercial or recreational value, the fisheries industry may be affected. When species are attracted to the structure of the array, they may be afforded some protection from fishing pressure due to their proximity to the facility if boats cannot reach them.

Anywhere vessels travel or facilities are placed, there is the risk of animals colliding with them or becoming entangled in anchor lines or cables. Collision and entanglement are of particular concern for threatened and endangered species of marine mammals and sea turtles.

There are different kinds of sound associated with the construction, operation and decommissioning phases of a facility. Sound perception and sensitivities vary by species with fish, turtles and marine mammals being the groups of primary concern. Platforms that are brightly lighted at night have been shown to attract fish that are normally diurnally active because the lights enable them to continue hunting even at night. The effect of electromagnetic fields on sensitive benthic and fish species, especially elasmobranchs, is incompletely understood. These fields could attract or deter animals. They could also affect a species' ability to locate prey, avoid predation or navigate. The reintroduction of contaminants into the water column during disturbance of the sediments is possible. Contaminants may also be introduced to the environment through spills or antifouling coatings. Careful consideration of these potential impacts is necessary in advance of development.

A complete picture of benthic habitats, the distributions and abundances of key species, and species use of habitats is important for making siting plans. Understanding habitat value, rarity and connectivity is essential to making environmentally sound choices for facility placement.

1.3.4 Social Science

Alternative Energy on the OCS is an emerging industry in the U.S. In order to fully comprehend the effects this industry may have on social and economic institutions the first step for MMS was to embark on a studies that capture these unique aspects of OCS alternative energy development.

Considering there has yet to be any OCS alternative energy development in the U.S. it is important to understand the baseline in which the industry will operate. That is, the energy market itself, capacity and the infrastructure needed are important to understand. How energy is produced and sold is a complex phenomenon. This, along with aspects of supply and demand in terms of geographic locations and type of energy used, is an important starting point in determining energy need. Critical to this market is the potential for the costs of energy to change with the introduction of new OCS alternative energy projects, perhaps with an initial rise in price followed by a drop after several years.

While developing the basis of understanding with respect to energy infrastructure and markets, the effects of these actions on society and economy must be examined. In order to do this MMS proposed a social and economic literature synthesis and workshop to aid in the development of a social science studies strategy for alternative energy.

Currently and to aid in the siting of technology testing and data gathering devises (see section 1.2 Project OCS Activities), there is a need to better document space-use on the OCS. Alternative energy on the OCS has the potential to conflict with other OCS uses. These uses may include oil and gas, sand and gravel, sea navigation, marine protected areas, recreational and commercial fishing, recreational boating, etc. The various space-uses should be documented, geospatially, in order for MMS to minimize conflicts and incorporate mitigation when decisions are made to develop areas of the OCS with multiple uses.

Following the workshop and the space-use study a social science research strategy will emerge. Nevertheless, there are some key issues which have become apparent throughout the development of the alternative energy program. The draft environmental impact statement and public hearings for the Cape Wind Energy project revealed that commercial fishing is a critical area that must be investigated thoroughly prior to any type of siting. Currently many of the shallow shoals that provide fish resources are also areas where wind developers are interested in placing wind parks. These areas also have potential to be recreational areas where boaters and recreational fisherman frequent. Therefore studies are needed that assess the impact from OCS alternative energy activities with respect to commercial fishing and recreation. This information will undoubtedly be needed for planning purposes and decision-making.

Alternative energy in the U.S. has many supporters but also many opponents. Indeed, Cluck (1998) maintains that environmental attitudes in the U.S. have been institutionalized across regions and demographic groups. Until recently with the work of (Krueger, 2007) it was somewhat unclear how this institutionalization manifested itself. Krueger (2007) found that

in Delaware, people are willing to pay more for electricity each month in order to bring OCS wind power to the state. Attitudes for OCS wind development are incredibly supportive and show a commitment and desire on the part of residents to move towards renewable energy as a source for electrical generation as opposed to the status quo of the current energy mix. Indeed, this research shows that people in Delaware care where their energy comes from. Studies such as this allow the Federal government to work with states in order to obtain a clear picture of how residents see the future of energy development. This allows states and communities to be proactive in their decision-making process.

SECTION 2.0 PROPOSED STUDY PROFILES

2.1 Introduction

The following sections focus on the proposed studies for FY 2009 and FY 2010. Additional information concerning the Alternative Energy Program can be found at http://www.mms.gov/offshore/RenewableEnergy/RenewableEnergyMain.htm.

2.2 Profiles of Studies Proposed for the Fiscal Year 2009 NSL

Table 1. Alternative Energy Studies Proposed for the Fiscal Year 2009

Page #	Discipline	Title	Rank
11	SS	OCS Alternative Energy and Space-Use Conflicts and Related Mitigation	1
13	HE	Survey of Digital Geographic Datasets on Benthic Habitats and Species Distribution and Methodologies for Data Viewing	2
15	SS	Worldwide Synthesis and Analysis of Existing Information Regarding Social and Economic Effects of Alternative Energy Uses on the OCS and Workshop	3
17	FE	Characterization and Potential Impacts of Noise Producing Construction and Operation Activities on the OCS	4

AQ = Air Quality FE=Fates & Effects HE = Habitat & Ecology
IM = Information Management MM= Marine Mammals and Protected Species
PO= Physical Oceanography SS = Social Sciences

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico/Pacific

Planning Area(s): North Atlantic, Mid-Atlantic, South Atlantic, Southern California, Northern California, and Washington-Oregon

Title: OCS Alternative Energy and Space-Use Conflicts and Related Mitigation

MMS Information Need(s) to be Addressed: Siting issues are extremely important in determining areas of possible alternative energy development. MMS decisions on lease sales must consider potential space-use conflicts on the OCS and consider how these conflicts differ during construction and operations. MMS needs to identify potential space use conflicts of OCS alternative energy development with other activities (e.g., fishing, navigation, sand and gravel extraction etc.), develop criteria for evaluating those conflicts, and identify mechanisms to mitigate existing conflicts and avoid future ones. This study will engage other Federal and state agencies to promote institutional and cross cutting thinking about multiple uses. Information from the study will be used in MMS decision making on siting and monitoring alternative energy development.

Cost Range: (in thousands) $500-$750 **Period of Performance:** FY 2009-2011

Description:

Background: The ocean accommodates a variety of uses that are separated by time of day, season, location, and/or zones set aside for specific users. Alternative energy development offers the potential for new use space conflicts with other existing uses of the OCS. Management of ocean space and resources have been addressed by a number of state, regional, and federal organizations – fisheries management councils, state task forces, and coastal zone management agencies, for example, but information on the various uses of these spaces and the potential conflicts as they pertain to alternative energy development are not well documented nor are they understood in terms of type of activity, duration, and timing. Space use conflicts was identified as a social, economic, and cultural concern in the synthesis of existing information on the environmental effects of alternative energy development on the OCS (Michel et al 2007). Avoidance and mitigation measures have not been fully developed for space use conflicts of alternative energy development with other uses, but need to be.

Objectives: The purpose of the study is to identify space use conflicts on the OCS between alternative energy development and existing and potential other uses of the OCS and ways to mitigate those conflicts.

Methods: The study will develop a geospatial database that is compatible with the MMS mapping system to assist in determining multiple uses offshore. Through a literature search

and key informant discussions, including lessons learned from the European experience, the study will develop a comprehensive list of detailed mitigation measures that can be applied to avoid adverse impacts between alternative energy and other uses that may be present in OCS and identify, develop, and evaluate specific proposals to mitigate or resolve potential spatial conflicts between these multiple uses. In addition, the study will explore the possibilities for creating or revising institutional linkages that might facilitate communication and cooperation between the various entities involved and establish a collaborative of key individuals that will develop techniques of co-existence.

Revised Date: March 20, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Area(s): North Atlantic and Mid-Atlantic

Title: Survey of Digital Geographic Datasets on Benthic Habitats and Species Distribution and Methodologies for Data Viewing

MMS Information Need(s) to be Addressed: The mid- and north- Atlantic areas support important commercial fisheries, provide habitat to numerous marine mammals, and are important to species migration. The Alternative Energy Workshop in June 2007 identified compilation and evaluation of geospatial data as a high priority need. This study will compile data that will provide MMS analysts and decision makers with information that can be used in a variety of tasks -- to evaluate proposed AE facility sites, conduct impact assessments, understand migration patterns, species density, importance of specific areas to specific species, routes in and around areas, and identify mitigation measures to avoid impacts. It potentially will identify data gaps that need to be filled through additional studies.

Cost Range: (in thousands) $450-$650 **Period of Performance:** FY 2009-2011

Description:

Background: The MMS has conducted little research in the mid- and north- Atlantic area recently. Most of the past work has been site specific and targeted rather than focused on broad geographic scales. With new activity in alternative energy likely to occur in the mid- and north- Atlantic areas, MMS needs comprehensive information about the distribution of other activities and resources in the area. GIS-based maps that overlay many types of information are needed for MMS to make critical decisions about Bureau-regulated activities, such as permitting and siting of development.

Geospatial data sets would be compiled from existing sources and would include biologic data such as benthic habitats, distributions of threatened and endangered species, commercially important species, and other indicator species. Geospatial data need to include migratory pathways, spatial and temporal distribution and habitat use for fish, marine mammals and turtles. Important habitats include soft bottoms, hard outcroppings, and artificial reefs. A topography layer is needed as the base.

Objectives: The purpose of this study is to identify and compile sources of existing digital geographic data on benthic habitats and species distributions into a single database with metadata for the data sources and evaluate potential methods for data viewing. The efforts will compliment ongoing efforts within MMS to provide a web-based data viewer for other information.

Methods: Digital geographic data for the mid and north Atlantic areas from Cape Hatteras to the border with Canada will be collected from existing sources. This could include data from other federal agencies such as U.S. Fish and Wildlife, NOAA fisheries, state natural resource departments, and university collections. Ideally, the source data will reside with the originator and the web viewer will access that information. Data validation and quality control will be needed before the maps are integrated into a single GIS system allowing the user to choose which components to overlay. A topography layer will be the base. Meta data on the source information will be provided that includes citations and descriptions of the resolution. Information on benthic habitats, threatened and endangered species, commercially important species and other indicator species will be collected. Migratory pathways and distribution of species in time and space will be included. Data gaps will also be identified.

Revised Date: October 31, 2007

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Headquarters

Planning Area: All

Title: Worldwide Synthesis and Analysis of Existing Information Regarding Social and Economic Effects of Alternative Energy Uses on the OCS and Workshop

MMS Information Need(s) to be Addressed: Potential impacts on the human and marine environments must be evaluated in order for MMS to make scientifically sound decisions about managing alternative energy activities. A literature search and synthesis followed by a workshop attended by experts in the field will be used to identify data gaps and recommend study needs for social and economic studies on alternative energy development. MMS needs this information to develop a social science research strategy on understanding the environmental impacts of alternative energy development on the human environment and coastal communities and economies.

Cost Range: (in thousands)**:** $200-$300 **Period of Performance:** FY 2009

Description:

Background: The alternative energy field is in the early stages of development and expansion in the United States, and the offshore environment represents new territory for industry expansion. Some countries in Europe are already exploring this area and may have valuable information to share that would help guide MMS's decision-making. Similarly, some States have begun development in near-shore environments and these projects could be useful examples to the new offshore activities that are already emerging.

The products from the "Synthesis and Analysis of Existing Information Regarding Environmental Effects of Alternative Energy on the Federal OCS" (Michel et al., 2007) provided some information, but additional information is needed before a social science research agenda is completed. The workshop planned as part of this study will be a first step for the MMS in communicating and developing a collaborative relationship with other Federal agencies, affected State and local groups, and industry on social and economic issues. Members of groups with knowledge about existing offshore alternative energy development (i.e., academia or representatives from countries or states where development is already occurring,) will be invited to share their expertise.

Objectives: The purpose of this study is to provide the information necessary for MMS to develop a social science research agenda on the environmental impacts of alternative energy on the human environment and coastal communities and economies.

1. Methods: The study will identify, collect, organize and evaluate the literature on the social and economic impacts of alternative energy development on the human environment and coastal communities and economies. The study will also organize and hold a 2-3 day workshop to gather and initiate a dialog among representatives from within MMS, other Federal agencies (including DOE, FERC, EPA, NOAA, etc.), States where development is most likely to occur in the near future, the alternative energy industry (including wind, current, wave, tidal and solar power, etc.), and academics and foreign experts in the field. Members of collaborative groups such as NOPP and CORE will be invited to foster partnerships in studies. The literature synthesis and the workshop will be used to identify data and knowledge gaps in the information available about the human environment with respect to top alternative energy issues and to develop and prioritize a list of social and economic information needs to fill those identified gaps. The workshop will also be used to initiate development of partnerships for information sharing and financial collaboration.

Revised Date: March 24, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Headquarters

Planning Area(s): All

Title: Characterization and Potential Impacts of Noise Producing Construction and Operation Activities on the OCS

MMS Information Need(s) to be Addressed: Offshore facilities generate noise during construction and operation. The impact of the pile driver on the piling results in substantial noise energy transmission within the water column. The MMS needs to understand the zone of influence of the sound generated by these activities in order to determine potential impacts to marine mammals, sea turtles, fish, and the surrounding habitat.

Cost Range: (in thousands) $350-$500 **Period of Performance:** FY 2009-2011

Description:

Background: The construction of offshore facilities will ultimately involve a considerable amount of noise for some period. To better understand the cumulative effects of noise from oil and gas construction and development activities on the OCS, the MMS will conduct a study to characterize all aspects of noise-producing construction and operation activities such as pile driving during well construction and platform installation, and of other common OCS activities including alternative energy.

The study will characterize both specific sources of noise from MMS-permitted actions, as well as ambient noise measurements on the OCS. Major noise-producing activities will be identified and measurements of noise from these activities will be recorded and reported in appropriate units of measurement to estimate the acoustic footprint of the activities, duration, frequency, and relative contribution to ambient noise levels. These data would help quantify the relative contribution of pile driving on ambient noise levels and consequently, the potential impact(s) on the OCS. This study should occur within the next two years and would include field work to evaluate the sound generated during such activities.

Objectives: The objectives of this study are to evaluate the potential levels of underwater noise generated from OCS activities, specifically pile driving activity of offshore facilities.

Methods: The methodology will consist of the review of existing information about the types and intensities of sound generated from pile driving. Field work will include measurement of sound generation from a facility before, during, and after construction. Field measurement methodology will be coordinated with appropriate NMFS personnel.

Revised Date: March 4, 2008

2.3 Profiles of Studies Proposed for the Fiscal Year 2010 NSL

Table 2. Alternative Energy and Alternate Use Studies Proposed for the Fiscal Year 2010

Page #	Discipline	Title
19	SS	Synthesis of Existing Information on Recreation and Tourism
21	SS	The Economic Impact of OCS Wind Development on Commercial Fishing
23	SS	Update and Digitization of Archaeological Baseline Studies Data for the Atlantic Planning Areas
25	SS	Alternative Energy Capacity Inventory in Coastal Alaska
27	HE	Field Surveys to Determine Abundance, Distribution and Flight Patterns of Waterbirds, Seabirds, and Seaducks in the Nearshore Atlantic
29	HE	Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities
31	HE	Potential Artificial Reef Effects of Offshore Wind Facilities
33	HE	Evaluation of the Soundscape and Potential Impacts of Noise to Marine Mammals and Turtles from Offshore Wind Facilities
35	FE	Survey and Evaluation of Potential Environmental Effects from Anti-fouling Paints, Lubricants, Hydraulic Fluids and other Chemical Products Potentially used at Offshore Facilities
37	FE	Fate and Effects of Spilled Transformer Oil (Dielectric Fluids) on the Marine Environment
39	FE	Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments
41	PO	Wave Attenuation Calculations for Various Designs of Wave Devices
43	PO	Energy Extraction from the Florida Current, How Many Turbines is Too Many?

AQ = Air Quality FE=Fates & Effects HE = Habitat & Ecology
IM = Information Management MM= Marine Mammals and Protected Species
PO= Physical Oceanography SS = Social Sciences

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico/Pacific

Planning Area(s): North Atlantic, Mid-Atlantic, South Atlantic, Southern California, Northern California, and Washington-Oregon

Title: Synthesis of Existing Information on Recreation and Tourism

MMS Information Need(s) to be Addressed: MMS will work closely with states to determine the best approach to meet their energy needs. Concerns have surfaced on the potential impacts that OCS wind development may have on recreation and tourism. Information on how these effects manifest themselves should be better understood in order for better decisions to be made with respect to specific locations and the economic impacts that may occur.

Cost Range: (in thousands) $250-$350 **Period of Performance:** 2010-2012

Description

Background: Many coastal areas receive a large percentage of their revenues from the tourism industry. The focus of most area tourism is the high quality of recreational activities the area offers. Tourism includes recreational activities such as: beach going, fishing, boating, boat racing, golfing, hiking, picnicking, sightseeing, and shopping. Guided tours and charters are also popular activities which may include; whale watching, wildlife, kayaking, canoeing tours, and bike tours.

It has been suggested that, if within the view shed, offshore wind development could have a negative impact on recreation and tourism (MMS EIS, OCS 2007-24). This could occur if individuals avoided recreational areas where development has occurred. In contrast, it has also been suggested that recreation and tourism may benefit from offshore wind structures by drawing onlookers.

Objective: The purpose of this study is to synthesize literature and collect and analyze data and that considers recreation and tourism employment, beach use, recreational boating, recreational fishing and income generated from these activities.

Methods: Literature reviews and data collection will be used to assess documents and describe behavior of coastal residents, recreational users, and tourists. These data will then be archived in a usable format to aid in the development of NEPA analysis. The information from secondary data sources will be used to create a baseline and subsequently predict the possible changes in business patterns as they relate to recreation and tourism and the overall economic performance of coastal communities within proximity of offshore wind development.

Revised Date: March 20, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Area(s): Mid-Atlantic

Title: The Economic Impact of OCS Wind Development on Commercial Fishing

MMS Information Need(s) to be Addressed: MMS will work closely with states to determine the best approach to meet their energy needs. Concerns have surfaced on the potential impacts that OCS wind development may have on commercial fishing. Information on how these effects manifest themselves should be better understood. MMS will work with NOAA's Fisheries Management Council in order to collect and synthesize the necessary data for better decisions to be made with respect to specific locations and the economic impact that may occur if these areas were temporarily restricted from fishing.

Cost Range: (in thousands) $500-$750 **Period of Performance:** 2010-2012

Description

Background: The Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended, provides the United States with exclusive management authority over fisheries, except for highly migratory species of tuna, within a fishery conservation zone of 3 to 200 miles offshore. The law was enacted to insure sound fishery conservation and management measures for both domestic and foreign fisheries. Eight regional fishery management councils were established to serve as planning units to carry out provisions of the Act. Each Council is directed to prepare fishery management plans for implementation by the Secretary of Commerce.

The Mid-Atlantic Council consists of representatives from New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. The Council consists of 25 members (21 voting, 4 non-voting), representing State and Federal agencies and the public. The voting members are the Regional Administrator of the National Marine Fisheries Service, a State fisheries official from each State, and thirteen public members nominated by the State Governors and selected by the Secretary of Commerce. Each State is entitled to at least one public member, with the remaining public members appointed at-large. The public members serve three-year terms. The non-voting members represent the Fish and Wildlife Service (Dept. of the Interior), the US Coast Guard, the State Department, and the Atlantic States Marine Fisheries Commission. A permanent staff, a Scientific and Statistical Committee, and an Advisory Panel are established to support and advise the Council.

The Scientific and Statistical Committee has twelve members appointed by the Council for two-year terms. The Council also appoints industry advisors to work with Council Committees during the preparation of fishery management plans and amendments

Objective: The purpose of the study is to determine geographic areas (using geospatial data) of the Mid-Atlantic where commercial fishing occurs and estimate the economic loss if those areas were restricted during construction, operations, and decommissioning of an offshore wind park.

Methods: A series of meeting with the Mid-Atlantic Fishery Management Council will take place. From these meetings, MMS will collect fisheries data that can be used to determine geographic areas (using GIS layers compatible with the MMS' system) in the Mid-Atlantic that are known fisheries. Estimates will then be made as to the potential economic loss to these specific areas. Interface will be established between these fisheries and the locations where industry interest on the OCS has occurred and been documented through the MMS Interim Policy process. The Interim Policy allowed for areas to be nominated for technology testing and research. The areas have been mapped and are in the MMS GIS data base.

Revised Date: March 20, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Areas: North Atlantic, Mid-Atlantic and South Atlantic

Title: Update and Digitization of Archaeological Baseline Studies Data for the Atlantic Planning Areas

MMS Information Need(s) to be Addressed: The MMS needs current historic, archaeological, and geological baseline information in digital format to identify where historic and prehistoric archaeological resources are most likely to occur on the Atlantic OCS. The MMS will use this information to prepare impact analyses for required NEPA documents, and to determine the archaeological survey requirements for all new projects proposed for the Atlantic OCS area.

Cost Range: (in thousands) $320-$480 **Period of Performance:** FY 2010-2011

Description:

Background: The MMS is required under the National Historic Preservation Act to ensure that the activities we permit do not adversely affect significant archaeological resources on the OCS. To meet this legal mandate, the MMS conducts archaeological baseline studies to synthesize existing historical, archaeological, geographic, and geological data pertinent to delineation of those areas of the OCS having potential for the occurrence of significant historic and/or prehistoric archaeological resources. The two existing archaeological baseline studies for the Atlantic OCS were completed in 1979 (Bay of Fundi to Cape Hatteras) and 1981 (Cape Hatteras to Key West). Since 1979 there have been several significant archaeological discoveries off the Atlantic coastline, including both historic shipwrecks and submerged prehistoric sites; and substantial new theories regarding the initial prehistoric peopling of the Americas which indicate that the Atlantic OCS may be the location of the earliest archaeological sites in the Americas. Major advances in marine survey technology and the development of digital data formats have also occurred since these baseline studies were completed. The maps produced by these early baseline studies are not only outdated, but extremely difficult to use for project-specific management decisions because they exist only in paper format.

Objectives: The objectives of this study are to:

- synthesize current information relevant to determining those areas of the Atlantic OCS having potential for historic and prehistoric archaeological resources
- develop an updated inventory of known historic shipwrecks
- recommend appropriate survey linespacing and instrumentation requirements to locate the various types of archaeological resources identified.

Methods: This study will entail:

- Review and evaluation of the information contained in the two existing Atlantic baseline studies
- Literature and archival research for new information on:
    - Shipwreck types, locations, and states of preservation on the Atlantic OCS compiled from a variety of original and secondary sources,
    - types, ages and geomorphic setting of prehistoric archaeological sites that have been discovered in the Atlantic coastal plain and nearshore areas
    - late Pleistocene/Holocene geology of the Atlantic continental shelf
    - late Wisconsinan relative sea-level change on the Atlantic OCS
- Revision and update of the shipwreck database for the Atlantic OCS
- Presentation of all study data with spatial data components in GIS format

Revised Date: February 21, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Alaska

Planning Area: All

Title: Alternative Energy Capacity Inventory in Coastal Alaska

MMS Information Needs to be Addressed: The Energy Act of 2005 delegated regulatory authority to MMS over renewable energy resources on the OCS. The new mandate requires fresh research about the range of opportunities, environmental implications, and potential social effects of renewable energy projects on a national, regional, and local scale. This study is designed to provide an initial inventory of plausible development opportunities and potential socio-economic consequences for residents of Alaska and select coastal communities. The information is needed for timely agency planning of the new regulatory authority.

Cost Estimate: (in thousands) $250-$400 **Period of Performance:** FY 2010-2012

Description:

Background: Renewable energy resources, such as solar, wind, tidal and geothermal power, are gaining credence as a viable means to offset the nation's dependence upon fossil fuels and reduce pollution emissions, as well as a means to reduce large international trade deficits, to improve national security, and to stimulate new prospects for economic expansion. Alternative renewable energy supplies convey great promise for the future, but they must be imagined within the context of existing and developing socio-economic and political relations, with a watchful eye upon the potential environmental, social and cultural consequences of a significant technological transformation.

Some of the paramount initial social questions must consider optimal opportunity for alternative energy development. Which regions of coastal Alaska are best poised to capitalize on opportunities from new technologies in the development of renewable energy? What are the predictable implications of tidal energy production in a specific region, such as Cook Inlet? What are the major parameters that will determine the economic feasibility of alternative energy projects in various regions of coastal Alaska? Will alternative energy technologies provide a wide range of socially desirable benefits to match the presumed environmental benefits? In what specific ways should government regulatory authorities attempt to manage a nascent development project in order to optimize positive social impacts and minimize any adverse implications?

Objectives: The objectives of this study are to: 1) establish firm intellectual understanding over the range of options, processes, economic feasibility, and potential management strategies that are relevant to development prospects for renewable energy sources on the OCS of Alaska and 2) systematically collect a variety of technical and socio-economic data to

produce a resource inventory database about the realistic prospects and related social impacts of specific alternative energy development scenarios for the Alaska region.

Methods: Conduct a systematic review of feasibility studies and project proposal scenarios for development of alternative energy resources in the State of Alaska. Conduct a literature review on social implications of alternative energy development. Identify and interview key experts from industry to document relevant technical details about the minimum thresholds necessary to achieve economic feasibility for specific project scenarios. Conduct a series of focus group sessions with relevant stakeholder representatives to explore and document the range of social perspectives about various alternative energy development scenarios and anticipated benefits and impacts. Produce a realistic development model and summary report to demonstrate lessons learned from the study.

Revised Date: December 31, 2007

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Headquarters

Planning Area(s) North Atlantic, Mid-Atlantic and South Atlantic

Title: Field Surveys to Determine Abundance, Distribution and Flight Patterns of Waterbirds, Seabirds, and Seaducks in the Nearshore Atlantic

MMS Information Need(s) to be Addressed: One of the major concerns regarding the development of wind power on the OCS identified at the 2007 Workshop is the potential impacts to birds, in particular those species that utilize the OCS for foraging, migration, and roosting. Existing information is sparse and additional data collection is needed to determine whether some areas of the OCS should be avoided due to high usage.

Cost Range: (in thousands) $2,000-$3,000 **Period of Performance:** FY 2010-2013

Description:

Background: The development of wind energy facilities has demonstrated onshore that siting is critical to minimize interactions with bird species. The workshop on alternative energy information needs (Michel and Burkhard, 2007) identified waterbirds, seabirds, and seaducks to be of species of concern because they often congregate on shoals, which are potential sites for offshore wind development. The USGS has already initiated the collection of all existing data along the Atlantic Coast for waterbirds, seabirds, and seaducks. The MMS is supporting an extension of this work to develop models correlating oceanographic data with bird distribution patterns. The modeling efforts will identify areas of higher bird usage, which can be subsequently evaluated for accuracy and will be used to identify data gaps for further analyses. This proposed study will be used to further expand the datasets and address key questions developed during the data analysis and modeling efforts.

One difficulty with existing data is that it is comprised of observations made from boats or planes. This data does not give directly give indications about patterns of movement, which is also critical for siting of wind energy facilities. In addition to actual field observations, radio-tagging techniques have been employed for the study of onshore bird movement patterns, and these methodologies may be employed to further understand the movements of waterbirds, seabirds, and seaducks.

Objectives:

- Assess Abundance and Distribution patterns of water birds
- Identify temporal patterns, foraging habitat and roosting areas.
- Identify patterns of flight (altitude, frequency, nocturnal, migration)
- Analyze the influence of weather (storms, clouds, rain, wind etc.) and life history traits on flight patterns

- Understand diurnal and nocturnal movements including dawn and dusk.

Methods: These data may be gathered variously by physical counts by boat and airplane, remote sensing by radar, tagging and historic record reviews. The methodology design will depend on the results of the ongoing data analysis study to determine the key questions to be addressed.

Revised Date: March 28, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Headquarters

Planning Area(s): All

Title: Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities

MMS Information Need(s) to be Addressed: The potential for impacts to bats from offshore wind development was identified as an area of concern by stakeholders. Basic information as to whether any bat species are at risk is unavailable at this time. The MMS needs to identify which bat species, if any, could be impacted by offshore wind facilities, and, if there are any, whether there are mitigation measures, such as not leasing a particular area, that may apply.

Cost Range: (in thousands) $75-$125 **Period of Performance:** FY 2010-2011

Description:

Background: The Energy Policy Act of 2005 granted MMS new responsibilities over Federal offshore renewable energy and related-uses of the OCS. Under this new authority, MMS also became the lead Federal agency of permitting and regulatory oversight of wind energy projects on the OCS. A recent workshop on alternative energy environmental information needs identified the use of the OCS by migratory bats as an area of concern (Michel and Burkhard, 2007). In a couple of instances, onshore wind facilities were sited in areas of bat migration, resulting in mortality of some of the bats. This experience along with some sporadic sightings of bats offshore has lead to the concern that in some locations, bats may be at risk from offshore wind facilities.

Bats are ranked among our most endangered wildlife according to the Fish and Wildlife Service (http://endangered.fws.gov/bats/bats.htm). Of the 45 kind of bats living in the United States, seven are in danger of becoming extinct. Many of these bats exist within the central United States. However, some bats do occur in coastal areas and may migrate between barrier islands and the coast. Currently, no comprehensive summary exists for the description of coastal migratory bats.

Objectives: This study will synthesize existing information about bat species that occur along coastal areas, summarize bat sightings, and identify those bats that are migratory and may be at risk from offshore wind energy facilities.

Methods: The methodology will consist of a literature review, data collection from public sources, discussions with key scientists, and analysis and synthesis of the collected data and information into a GIS relational database and final report.

Revised Date: January 22, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Area(s): North Atlantic, Mid-Atlantic and South Atlantic

Title: Potential Artificial Reef Effects of Offshore Wind Facilities

MMS Information Need(s) to be Addressed: The installation of offshore wind facilities will lead to the creation of artificial reefs. The base of each monopile will include scour protection that could be created from a number of materials, resulting in a range of impacts. Information about the alteration of the environment is needed for MMS approval of different scour prevention materials. Stakeholders have raised concerns about the potential impacts of this altered ecosystem to local marine species and commercial fishing.

Cost Range: (in thousands) $175-$225 **Period of Performance:** FY 2010-2011

Description:

Background: Wind facilities will involve the installation of tens to hundreds of structures in a relatively small area leading to the creation of artificial reefs. Each monopile may require the use of scour pads or some other material to reduce sediment transport around the base. These materials will also increase available hard substrate and further the creation of an artificial reef system. The MMS has extensively studied the alteration of the environment by the placement of oil and gas structures on the OCS. The interaction of oil and gas structures is very different, providing a lattice work of surface area. Monopiles will consist of a single cylinder with a diameter of approximately 5 meters. However, tens to hundreds of these will be placed in relatively close proximity providing a different type of interaction. Scour protection will also add a different type of substrate to the local environment.

The first wind facilities are expected to be placed along the Atlantic coast in relatively shallow water (~20 meters). This study will build on information gathered from the compilation of information about benthic habitats and examine the potential impacts from placing these structures in the existing mix of hard and soft substrate. Artificial reef effects of concern include alteration of the benthic environment, attraction of fish species, attraction of prey for marine mammals and sea turtles, creation of a protective environment that attracts sea turtles, and potential range expansion of both native and invasive species. The study will also summarize the different types of scour protection currently available and the potential impacts to the environment.

Objectives: This study will evaluate the potential artificial reef effects from the development of offshore wind facilities along the Atlantic Coast. The study will also summarize and evaluate various scour protection materials and their potential to affect the benthic environment.

Methods: The methodology will consist of a literature review, calculations of potential areas of effect, gathering information from key scientists, and analysis and synthesis of the collected data and information.

Revised Date: January 22, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Area(s): North Atlantic, Mid-Atlantic and South Atlantic

Title: Evaluation of the Soundscape and Potential Impacts of Noise to Marine Mammals and Turtles from Offshore Wind Facilities

MMS Information Need(s) to be Addressed: Offshore wind facilities will generate noise during construction and operation. The MMS needs to understand the zone of influence of the sound generated by these facilities in order to determine potential mitigation of impacts to marine mammals, sea turtles, and fish. One key issue is whether the operation of these facilities will affect the soundscape.

Cost Range: (in thousands) $800-$1,000 **Period of Performance:** FY 2010-2013

Description:

Background: The construction of offshore wind facilities will involve geological and geophysical work, construction, operations as well as decommissioning ultimately generating a significant amount of noise for some period of time. Anthropogenic noise in the environment can alter the behavior of some marine species and force them to leave an area that may be critical habitat. During pile driving, marine species such as sea turtles can be injured, if they are too close to the sound source. Wind facilities will also be equipped with foghorns to prevent collisions during foggy weather. The intensity and duration of these sound sources can determine the extent of the impact.

Some information is available from the European wind facilities and is summarized in the synthesis report prepared for MMS (Michel et al., 2007). Whether the impacts from sound would translate to the Atlantic Coast is dependent on the species that may be impacted and the sound generated. The impacts of sound also depend on the underwater landscape of an area. Ideally, data about noise should be collected during the actual construction and operation of a facility. This may occur within the next few years and this study would include field work to evaluate the sound generated during these activities.

Objectives: The objectives of this study are to evaluate the potential levels of noise generated from pre-construction through decommissioning of a wind facility.

Methods: The methodology will consist of the review of existing information about the types and intensities of sound generated during the construction and operation of a wind facility. Field work will include the use of equipment such as passive acoustic monitoring to measure the generation of sound from a facility before, during, and after construction.

Revised Date: January 22, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Headquarters

Planning Area(s): All

Title: Survey and Evaluation of Potential Environmental Effects from Anti-fouling Paints, Lubricants, Hydraulic Fluids and other Chemical Products Potentially used at Offshore Facilities

MMS Information Need(s) to be Addressed: Offshore alternative energy facilities will require the use of anti-fouling paints, lubricants, and hydraulic fluids among other chemicals. These chemicals will come into contact with the marine environment either directly or through small spills. The impacts will depend on the composition of the paint, lubricant, or fluid used. MMS needs information about these chemicals to develop appropriate mitigation measures.

Cost Range: (in thousands) $100-$150 **Period of Performance:** FY 2010-2011

Description:

Background: The installation of commercial facilities for the generation of electricity through renewable energy will require the use of tens to hundreds of devices. Each of these devices will be painted with anti-fouling paints and will use lubricants and hydraulic fluids. Some paints and fluids have the potential to cause greater or lesser impact to the environment depending on the composition. Stakeholders have expressed their concern about the types of chemicals that may be used (Michel and Burkhard, 2007). In the past, antifouling paints have included chemicals such as tributyltin and copper, which can have detrimental impacts to the environment. Other types of chemicals or products that may be used include blasting agents for surface preparation and coatings used above the waterline. The potential impacts to the environment will depend on the frequency with which the chemicals are replaced or reapplied and a description of the application process. The MMS will need to evaluate the potential environmental impacts from the use of these chemicals and must ensure that appropriate chemical handling procedures and spill response are used.

Objectives: The study will compile information about the various types of anti-fouling paint, lubricants, hydraulic fluids, and other chemicals or products available and identify, where possible, the potential environmental impacts from the use of these chemicals. The study will also evaluate spill response capabilities for the potential types of spills.

Methods: The methodology will consist of a literature review, data collection from public sources, discussions with key industry representatives, and analysis and synthesis of the collected data and information.

Revised Date: March 28, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Pacific

Planning Area: Southern California

Title: Fate and Effects of Spilled Transformer Oil (Dielectric Fluids) on the Marine Environment

MMS Information Need(s) to be Addressed: There is very little knowledge of the effect that dielectric fluids would have if spilled into the marine environment. MMS will need to know, in the event of a spill, what effects this dielectric fluid would have on the marine environment including sea birds, marine mammals, fish eggs and larvae, and shorelines.

Cost Range: (in thousands): $100-$200 **Period of Performance:** FY 2010-2011

Description:

Background: The Alternative Energy/Alternative Use program includes the placing of potentially dozens of ESPs on the OCS. Electrical cables run from individual wave, current, wind, or other type of alternative energy generation devices to the ESP where the electricity is changed in voltage by large transformers. Each of these transformers contains thousands of gallons of dielectric fluid, often a mineral oil, sometimes other types of fluids such as those made from soy beans. There is no specific knowledge of the effects of a spill of dielectric fluids on the marine environment. While some drilling fluids contain mineral oil and some of these fluids have been spilled, these events are rare, the volumes small, and no studies have been conducted to examine the effects.

Although large transformers do exist on oil and gas platforms on the OCS, the emphasis regarding the effects of oil spills has been on crude oil. Because alternative energy projects will nearly always include an Electrical Service Platform (ESP) holding one or more large transformers which contain thousands of gallons of dielectric fluids, MMS will need to know, in the event of a spill, what effects this dielectric fluid would have on the marine environment including sea birds, marine mammals, fish eggs and larvae, and shorelines. While information on crude oil and its effects on marine life is well-known, much less if anything is known about mineral oil or other oil-like fluids commonly used in transformers. Note that the actual on-water behavior of spilled dielectric fluid (e.g., spreading, evaporation, emulsification tendencies, etc.), the ability to clean it up (e.g., best types of booms, dispersibility and burnability, etc.), the frequency and volume of spills would best be studied by the Technology and Research Branch and probably include tests at OHMSETT.

Objectives: Research objectives include 1) an exhaustive literature search, including European sources, which would provide a foundation of knowledge for this topic; 2) an assessment of the effects of dielectric fluids on marine mammals, sea birds, fish, fish eggs and larvae, and other sensitive biological resources; 3) an assessment of the impacts to shoreline communities

(e.g., sandy, rocky, etc.) using existing shoreline community sensitivity information; and 4) a summary of knowledge gaps based on the results of the objectives above.

Methods: Internet and library research as well as interviews of persons knowledgeable about this topic are necessary. No field work is anticipated.

Revised date: February 28, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Area(s): North Atlantic, Mid-Atlantic and South Atlantic

Title: Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments

MMS Information Need(s) to be Addressed: The lighting of offshore wind facilities will determine the level of impact to the surroundings as well as provide for the safety of other users of the area.

Cost Range: (in thousands) $175-$225 **Period of Performance:** FY 2010-2011

Description:

Background: The selection of lighting for offshore wind facilities will require the balancing of several requirements. The lighting will need to meet Federal Aviation Administration requirements while minimizing impacts to birds and onshore development. Various lighting schemes for onshore wind facilities and communication towers have been evaluated for their interaction with birds, as well as impacts to nearby housing developments or historic properties. The impacts involve the intensity of the light, the color, how the light is directed, and the rate of blinking. The best scheme for offshore facilities may differ because of the configuration and size of the wind towers and for their potential to interfere with established flight patterns. Also, because of their height, these lights may be visible from shore and impact coastal communities and historic properties.

Lighting near the sea surface will need to meet Coast Guard requirements as well as minimize effects on sea turtles, fish, and other marine species. The configuration of the facility, the location of shipping lanes, and the type of vessels allowed within the facility will be important for determining the type of lighting. Lights may attract turtles, fish, and possibly marine mammals.

Objectives: This study will evaluate the potential lighting schemes for offshore wind facilities, describe air traffic and vessel traffic usage along the East Coast and how that will affect lighting options, and the impacts of these lighting options on marine and coastal species and the human environment.

Methods: The methodology will consist of a literature review, data collection from public sources, discussions with FAA and US Coast Guard representatives, and analysis and synthesis of the collected data and information.

Revised Date: January 22, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Pacific

Planning Area(s): Northern California, Washington-Oregon

Title: Wave Attenuation Calculations for Various Designs of Wave Devices

MMS Information Need(s) to be Addressed: Installation of a large numbers of wave devices may affect on the local wave environment. The amount of dampening will depend on the design, number, and spacing of the wave devices. Both direct measurements and models are needed to understand and minimize the impacts from the designs.

Cost Range: (in thousands) $400-$600 **Period of Performance:** FY 2010-2011

Description:

Background: Numerous wave facilities are currently proposed along the Pacific Coast. Several designs for devices have been proposed including both point absorbers and attenuators (Michel et al., 2007). Commercial development using these devices will require installation of tens to hundreds of the devices in a relatively small area (a few square miles). Since these devices are designed to remove kinetic energy from waves to generate electricity, the amount of dampening or altering of the wave regime is in question. While OCS facilities will be located greater than 3 nautical miles from shore, there is still concern that these devices could alter the wave energy resulting in changes in sediment transport and beach nourishment. Some have expressed concern that surfing will be affected.

Evaluation of the potential dampening will require the use or creation of a model to examine the wave field on the scale of a few hundred feet and to allow for the addition of multiple devices as potential dampeners. Key unanswered questions include: Will the waves be dampened, and if so to what extent? Is there some maximum density of devices that can be emplaced with minimal alteration to the environment? Is there a difference in wave attenuation depending on the configuration or placement of the devices? The use of a model may assist in answering these questions. Field measurements made during the testing of devices would be used to acquire data to verify the model. The implications of altering the wave or current regime would also need to be addressed.

Objectives: The study will evaluate the effects of wave facilities on the local wave environment.

Methods: The study would include monitoring of alterations in the wave environment by individual wave devices as they are being tested in the marine environment. The information collected would be used to develop new models or alter existing models of wave attenuation.

Revised Date: January 22, 2008

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2009-2011

Region: Gulf of Mexico

Planning Area(s): Straits of Florida

Title: Energy Extraction from the Florida Current, How Many Turbines is Too Many?

MMS Information Need(s) to be Addressed: A key question concerning the development of ocean current technology is how much energy can be extracted from a current before it is affected. Planning for the level of leasing activity and permitted facilities will depend on the upper limit of current extraction.

Cost Range: (in thousands) $350-$500 **Period of Performance:** FY 2010-2012

Description:

Background: The use of ocean currents for the production of electricity is not a new concept. In the early 1970's, a conference was held to discuss the potential for extraction of energy from the Florida Current and Gulf Stream. An upper limit of 4% was calculated for the extraction of energy and reported at this conference (von Arx, 1974). Our understanding of the Gulf Stream has evolved since that time. The extraction of energy from currents may involve a large number of structures that not only will extract energy to turn their turbines, but also be a source of friction that may reduce the current speed. Before development is proposed, the question of cumulative impacts from multiple devices to multiple facilities needs to be addressed. The information from this study could affect the design characteristics of marine current devices and determine whether commercial ventures are even possible.

Objectives: The objective of this study is to evaluate the upper limit of the amount of energy that can be extracted or lost from the Florida Current/Gulf Stream before the current is altered.

Methods: A literature search of existing information about the Florida Current/Gulf Stream including flow rates, geographic extent, and other relevant information will be conducted. A survey of the potential marine current device designs will be conducted to evaluate frictional effects. An estimation of the total amount of energy that may be extracted will be calculated from the available information.

Revised Date: March 28, 2008

3.0 TOPICAL AREAS FOR FISCAL YEAR 2011 AND BEYOND

Topical areas for future studies of environmental concerns for alternative energy development include continued collection of baseline data in frontier areas; monitoring of projects during construction and operation; future environmental concerns for specific technologies; and cross-cutting issues that apply to any development on the OCS. Topical areas also include overarching themes such as global climate change and the benefits of OCS energy development. Questions arise such as: Will development of renewable energy make a difference in global climate change by decreasing greenhouse gases? Skeptics suggest that it would take many years to reverse the trends. However others suggest that these steps towards renewable ocean energy are critical for the US to take. These issues will be explored using scientific information from around the world.

3.1 Baseline Data

Of critical importance is the collection of baseline data prior to development. Baseline information for key species such as fish, birds, marine mammals, invertebrates among other biological resources are important to obtain in areas of new development. Initial studies were identified earlier in this plan that focus on the initial areas of interest, but as development expands, new areas will require syntheses of existing data as well as the collection of new information. Indeed, many scientists suggest a minimum of two years of data is necessary. Baseline information will be used to better understand ecosystem dynamics and evaluate the alteration in habitat as a result of alternative energy development. Scientists must also identify coastal threatened and endangered species of plants, insects and sea-grass. In addition, baseline data of human uses of the ocean is important to collect. This involves data on fishing, navigation, subsistence and general recreational uses.

3.2 Monitoring

Since offshore alternative energy has not yet been developed, a great opportunity is available to monitor the interactions between the technology and the environment as the technology is being developed, deployed, and operated. An overall theme is to develop standardized monitoring protocols. This includes protocols for monitoring fish, turtles, marine mammals, birds, benthos, etc. How do you measure the impact of facilities on these resources? What levels of impacts are significant? If impacts are significant, how are they mitigated? Questions arise as to the best monitoring technologies to use in order to assess the interaction of technology with the environment. Many scientific monitoring technologies are currently under development, many with promising results.

Certain species are of particular concern because of their designations as threatened or endangered such as the North Atlantic right whale, piping plover, and roseate tern along the Atlantic Coast. Monitoring of these species and potential impacting factors during construction such as pile driving and vessel traffic will need to be conducted.

Monitoring of facilities for attraction of sea turtles by lights and food sources post-construction is also important. Project displacement of recreators, living resources and

habitats should be conducted. Monitoring devices can also be placed near structures during pilot stages in order to evaluate interactions with the ecology. The interactions with the ecology is not only important within the project footprint but along the shoreline. Therefore, shoreline morphology monitoring should take place.

3.3 Wind Technology Issues

While wind technology is the most advanced and significant research has been conducted in Europe, there are still many questions to be answered as development moves forward along the US coasts. European offshore wind energy efforts are focused mainly in the North Sea, where wind speeds are high and water depths are relatively shallow. Wind turbine spacing as well as spacing for the entire wind park is a consideration in terms of the environmental footprint. The public has commented that a condensed configuration of wind turbine generators may mitigate visual impacts. However, there are questions as to how a condensed configuration may impact commercial fishing as well as reef effects. In addition, consideration must be given to economic impacts in terms of a reduction in property values of coastal residents. While studies have shown that onshore wind parks do not have a negative effect, this has yet to be analyzed for offshore wind parks in the United States because of their absence.

European studies have shown adverse impacts from noise generated from the construction phase of development (i.e. pile driving). Impacts are species specific and proper mitigation should be developed to minimize these impacts.

Scour effects and stability of shoals where development occurs could impact several species. It is important to establish acceptable limits to modification of the environment by physical processes so as to have minimal impact on the ecology.

Additional technologies will need to developed and improved in order to better monitor bird strikes. Avian impacts are one of the most important wind development issues. Not only are additional technologies important but improved predictive models are also necessary to better estimate bird interactions with wind turbines.

The cumulative effects from multiple projects along the coast are a concern. How closely should facilities be spaced? What level of habitat alteration can be absorbed by the coastal ecosystem? What will be the acceptance of communities to multiple facilities including aesthetics and recreational impacts?

3.4 Wave Technology Issues

Wave technology is rapidly evolving with several designs being developed simultaneously. The specific design will determine the type of interactions that a wave facility will have with the environment. In all cases though, a wave facility would consist of a large array of relatively closely spaced devices. This type of design will probably preclude the use of the ocean area for other activities, including recreation and commercial fishing. A key concern is how the displacement of recreators and fishermen will impact the surrounding areas and will

this impact local tourism. The displacement could also impact community acceptance of offshore wave development.

The close spacing of wave devices also raises issues about impacts to fish and marine mammal migratory routes. Will these arrays be an obstacle to migratory pathways, both along shore and to/form shore? Will an array generate noise that will act as either a deterrent or an attractant for fish, sharks, and other species resulting in "attractive nuisances"? All wave designs require that the devices be moored to the seafloor which could result in entanglement of diving sea birds, marine mammals, or turtle species. The close spacing may alter the local habitat and attract sea birds because of the lighting and perching opportunities.

The cumulative effects from multiple facilities along the coast are also a concern. What would be the maximum area of occupancy for wave facilities? Would this be based on local energy needs, alteration of the marine environment, or a resolution of space use conflicts? The cumulative effects include aesthetics and recreational impacts as well as impacts to marine species.

Other considerations include thermal impacts for the wave devices, above water noise from the devices, aesthetics of a wave facility, sunlight blockage or shadowing by the wave devices, and the potential environmental consequences from accidental events such as a lost buoy. Some wave device designs include water withdrawal that may lead to impingement or entrapment of larvae or small organisms.

3.5 Ocean Current Technology Issues

While it is expected that development of ocean current facilities will not occur in the near future, some design testing is planned. The design will probably incorporate a turbine deign similar to technologies being tested to extract energy from tides. The environmental concerns are similar as for any development offshore, including space use conflicts and alteration of habitat. The interactions of fish, turtles, and marine mammals with underwater turbines are a key concern.

3.6 Cross-Cutting Issues

Alternative energy in the U.S. has many supporters but also many opponents and cuts across geographic regions, demographic groups and income levels. Indeed, Cluck (1998) maintains that environmental attitudes in the U.S. have been institutionalized across regions and demographic groups. Until recently with the work of (Krueger, 2007) it was somewhat unclear how this institutionalization manifested itself. Krueger (2007) found that in Delaware, people are willing to pay more for electricity each month in order to bring OCS wind power to the state. Attitudes for OCS wind development are incredibly supportive and show a commitment and desire on the part of residents to move towards renewable energy as a source for electrical generation as opposed to the status quo of the current energy mix. Indeed, this research shows that people in Delaware care where their energy comes from. Studies such as this allow the Federal government to work with states in order to obtain a

clear picture of how residents see the future of energy development. This allows states and communities to be proactive in their decision-making process.

Another cross-cutting issue is global climate change and the benefits of OCS alternative energy development on the environment and human communities. Many questions arise when considering the effects of alternative energy on global climate change. What are the greenhouse gas emission impacts from construction, maintenance, and removal? Will development of renewable energy make a difference in global climate change by decreasing greenhouse gases? Skeptics suggest that it would take many years and significant developments to reverse the trends. However others suggest that these steps towards renewable ocean energy are critical for the US to take. A thorough cost/benefit analysis of these projects is needed.

A worldwide analysis of manufacturing of OCS alternative energy technologies is needed to trace the most likely manufacturing aspects of commercial and non-commercial OCS alternative energy proposals. Manufacturing of wind turbines as well as other types of wave and current technologies are limited within the world. Indeed, the US could become a leader in manufacturing for offshore alternative energy, but first it is important to understand the current state of manufacturing before determining the possibilities. The location of manufacturing is important for the economics of Nations (Denmark) and States (Oregon). An analysis of the worldwide manufacturing OCS alternative energy technologies allows countries to predict the economic benefits in terms of employment and income.

Eventually, decommissioning impacts will need to be considered including the methods of removal and potential effects of leaving structures in place.

Other cross-cutting considerations include interactions with offshore mariculture; risks from natural disasters such as hurricanes, earthquakes, and tsunamis; determining the need for exclusion zones around facilities; evaluating the reliability of equipment; and homeland security.

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