Paper #2-12

OFFSHORE TRANSPORTATION

Prepared by the Offshore Operations Subgroup
of the
Operations & Environment Task Group

On September 15, 2011, The National Petroleum Council (NPC) in approving its report, *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Task Groups and/or Subgroups. These Topic and White Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic and White Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached paper is one of 57 such working documents used in the study analyses. Also included is a roster of the Subgroup that developed or submitted this paper. Appendix C of the final NPC report provides a complete list of the 57 Topic and White Papers and an abstract for each. The full papers can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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EXECUTIVE SUMMARY

Ocean vessels and helicopters comprise two separate classes of essential transportation services for offshore oil and gas projects and both classes will be needed in their respective roles for the foreseeable future. Ocean vessels and helicopters that operate in or above the US Outer Continental Shelf (OCS) are regulated by US federal agencies that include the US Coast Guard (USCG; vessels) and the Federal Aviation Administration (FAA; helicopters).

Ocean vessels and helicopters involve different sets of potential environmental impacts. Helicopters are associated with air emissions, potential noise disturbances of birds and marine mammals and also with potential collisions with birds in flight. Ocean vessels are associated with air emissions, liquid discharges, and potential noise disturbances of marine mammals or collisions with marine mammals. In addition, ocean vessels can be associated with release of invasive (non-native) species and with disturbance of coastal waterways and wildlife habitats. Noise or potential chemical pollution from vessels is regulated by a collection of different federal regulations that are enforced by the USCG.

Beginning in the 1980s, baseline data on air emissions from ocean vessels and helicopters that support offshore oil and gas projects were collected by the Minerals Management Service (MMS) which was replaced by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in 2010. But no similar monitoring of other transportation impacts, including marine mammal or bird disturbances, has been conducted by federal government agencies.

Specific findings are:

- Regulation of ocean vessels supporting offshore oil and gas projects in the Gulf of Mexico has been led by the USCG although with a long-standing reliance on various maritime shipping, ship-building and petroleum industry professional groups ("classification societies") for support on certification of operating and inspection standards. Future success of offshore development will depend on continuing improvements to communications and collaborations between the USCG and the industry groups.

- Regulation of helicopters supporting offshore oil and gas projects has been led by the FAA but with the benefit of proactive aviation industry groups who track incidents and promote safe operating practices. Future success of offshore development will depend on continuing improvements to communications and collaborations between the FAA and the industry groups.

- Development of baseline data on transportation-related environmental impacts, beyond the limited dimension of air emissions, requires a new source of effort either by BOEMRE or by joint industry-government initiatives.

INTRODUCTION

The development and maintenance of offshore oil and gas facilities requires a fleet of offshore service vessels specially suited to the demands of the marine environment. From the initial exploratory work to the long-term deployment of oil and gas installations, offshore service vessels may include crew and supply boats, utility boats, seismic ships, anchor handling tugs, diving support, well stimulation ships, lift boats and pipe laying vessels. As field developments move farther offshore and the cost and complexity of services increase, there is an increasing demand for larger-sized and multi-tasking capabilities of these vessels to not only transport cargo to deep water facilities but to also conduct mooring, installation, and fire fighting operations in a wide variety of offshore environments.

Helicopters are also routinely used to service offshore facilities, primarily for transporting crew and conducting emergency evacuations but they may transport equipment and supplies, as well. Deep water operations have likewise lead to increased demand for enhanced helicopter capabilities such as the ability to travel farther and faster, carry more personnel, have all-weather capability, and reduced operating costs

REGULATORY STRUCTURE

Over 95% of the service vessels that serve the offshore industry are US flagged, as compared to the over 95% of deep draft cargo ships and tankers entering US ports carrying international cargoes of merchandise and oil. US offshore support vessels are highly regulated falling under the jurisdiction of US Coast Guard (USCG) for safety, construction, manning, operations and pollution prevention; US Environmental Protection Agency (EPA) for pollution prevention; US Department of Transportation (DOT) for cargo carriage; DOT for drug and alcohol programs; US Occupational Safety and Health Administration (OSHA) for safety; and also state agencies.

All offshore support vessels, whether US or foreign flag, are subject by treaty to international conventions on maritime safety developed by the International Maritime Organization (IMO). IMO conventions (IMO, 2011) on crew competence (STCW), security (ISPS), safety (SOLAS), pollution prevention (MARPOL) and cargo (packaged, liquid or bulk dangerous goods codes) are generally much more stringent than their domestic (US) counterparts.

Vessels supporting offshore activities are required to carry oil-spill liability insurance and hold USCG approved spill response plans.

All offshore support vessels (US and foreign flag) are subject to annual regulatory compliance inspections by the USCG and their flag state.

Classification societies are commercial organizations that set vessel construction and equipment standards. Vessels are issued “class” notations stating their conformance to their classification society standards based on annual class society “surveyor” inspections. Insurance companies issue policies and set rates for vessels according to class society documentation.

In the case of regulatory inspections designated commercial organizations called classification societies may be authorized to conduct annual compliance inspections and issue compliance documents on behalf of the vessel's flag state government. While world-wide there are over 40 classification societies only three meet the high standards set by the USCG to conduct inspections on behalf of the US government: ABS (formerly American Bureau of Shipping), Det Norske Veritas (DNV) and Lloyd's Register Group.

A classification society can also be delegated authority by a flag state to conduct certain required vessel examinations on behalf of the flag state. The USCG's Alternate Compliance Program (ACP) relies upon these organizations to perform inspections on their behalf. The ACP is intended to reduce the regulatory burden on the maritime industry while maintaining existing levels of safety and providing increased flexibility in the construction and operation of US flag vessels. The ACP is a voluntary process that is meant to provide oversight equivalent to Title 46 of the US Code of Federal Regulations (CFR) which prescribes regulations for obtaining a Certificate of Inspection (COI). The program involves compliance with the standards of an authorized classification society, International Conventions, and a current US Supplement, which specifies additional requirements of the USCG. The ACP is administered through surveys and inspections conducted by authorized classification society surveyors.

The Oil Companies International Marine Forum (OCIMF) recently created an Offshore Vessel Inspection Database, a voluntary inspection program for evaluating safety and environmental performance of offshore support vessels. While a "voluntary" vessel inspection under the program is required by the major oil companies, the inspections are heavily weighted to evaluate both the physical condition of a vessel and vessel compliance with the company's safety management system. The format is similar to the Tanker Managers Self Assessment, which is used in conjunction with the Ship Inspection Report (SIRE), another voluntary program (OCIMF, 2004). The database ties together with the Offshore Vessel Management and Self Awareness (OVMSA) program, which encourages vessel operators to assess their safety management systems against listed performance indicators and the results of these assessments can then be used to develop continuous improvement plans to achieve safety and environmental excellence. There are at least 19 different vessel categories that could be used in the database including: seismic, diving, drilling, ice breaking, pipe laying, anchor handling, supply operations, oil recovery and crew boat.

The Federal Aviation Administration (FAA) regulates helicopter flight patterns. Requirements for offshore helicopters are contained in the following two regulatory categories: 1) operators who transport their own employees are under Title 14 CFR Part 91, and 2) flights conducted for hire are under Title 14 CFR Part 135. Part 91 pertains to general operating rules for all aircraft, while Part 135 contains more stringent standards for commuter operations.

The FAA is proactively moving away from compliance–based safety surveillance programs to Systems Safety Risk Management programs to eliminate air carrier's accidents and incidents. The FAA has found that the compliance-based oversight system was not effective in reducing the causal factors that lead to air carrier accidents. System Safety Risk Management programs is now being applied to CFR Part 135 air carriers. These safety programs are not mandatory but are encouraged by the FAA to generate safety information that may not otherwise be obtainable. They are considered to be safety-critical processes to ensure that an organization is managing hazard-related risks in an operating environment.

ENVIRONMENTAL EFFECTS RELATED TO MARINE VESSELS

As of June 2010, the USCG estimates there were 1,307 US-flagged and 67 foreign-flagged support vessels operating on the Outer Continental Shelf (Cook, 2010).

A. Coastal Habitats

Aquatic ecosystems and coastal habitats in the US have long suffered from a myriad of anthropogenic effects. Some of the highest wetland losses in the nation have been occurring in regions where federal work projects were implemented over the last century to create canals, floodgates, levees and water-control structures to lessen the risks from floods on agriculture, urban development, energy-related industries and commercial transportation. The development of ports and water-borne commerce in those sensitive coastal regions are among the factors that have impacted those areas as a result of facilities construction; channel dredging; noise, air emissions and collisions on species; and routine or accidental discharges.

The US Gulf of Mexico (GOM) supports a well-developed marine transportation system comprising ports and terminals with a wide range of capabilities. Those facilities range from small shallow-draft ports to some of the nation's largest port complexes. These GOM ports also contribute more than $50 billion annually to the US economy and provide almost three-quarters of a million jobs directly related to port activity.

The great majority of vessels supporting OCS activities work from ports and terminals located along the coastline. The use of terminals adjacent to the GOM reduces the potential negative impact of the daily operations those vessels might have on the fragile wetlands environments. While there is some traffic of offshore support vessels to and from inland ports, such traffic is primarily for vessels to undergo maintenance, repair or dry-docking at shipyards and repair facilities, not to conduct daily activities.

Wakes generated by boats, ships, barges, and other vessels erode unprotected shorelines and accelerate erosion in areas already affected by natural erosion. A 1989 study to investigate the direct impacts on OCS navigation channels suggests that construction and maintenance of navigation channels is primarily focused on the engineering aspects of the channel and that monitoring the effects of those activities was practically non-existent (Wicker et al., 1989a,b). The US Army Corps of Engineers (USACE) has recognized over the past few decades that many mistakes made in the past related to maintenance dredging, the construction of jetties and design of navigation channels have been very expensive and sometimes irreversible but lessons have been learned that are being used to better plan and design future projects (Parchure & Teeter, 2002). Service vessels as well as other users of navigation channels are expected to continue to impact coastal habitats including wetlands but with improved understanding of natural processes and ongoing restoration efforts, the effects can be mitigated over time.

B. Air Emissions

The discussions of air emissions from offshore support vessels below must be considered in the context of current practice. While past studies, past conditions and past operational practices comprise the current documentation and study, many things have changed significantly since these studies were conducted. In the time since the studies listed below were conducted, offshore support vessels (as opposed to foreign flag deep draft shipping) have switched to ultra low sulfur diesel fuels, new engine exhaust (engine design) standards have been implemented by the EPA, and industry-wide efforts at fuel conservation have become commonplace. All of this contributes to a lessening of the impact from offshore support vessel emissions, especially in the areas of nitrogen oxides (NOx), sulfur dioxide (SO_2) and particulate matter (PM). The switch to ultra-low sulfur diesel by vessels also impacts the platforms and other facilities offshore.

To assess emissions from offshore oil and gas platforms and their associated operations, the Minerals Management Service (MMS), which in 2010 was replaced by Bureau of Ocean Energy Management, Regulation and Enforcement, BOEMRE), began conducting limited emission inventories in the 1980s in the GOM OCS. Over the past 15 years, there have been progressively more detailed studies and the latest 2008 Gulfwide Emission Inventory Study was released in draft at the end of 2010 (Wilson et al., 2010). That study builds upon previous inventories of all OCS oil and gas production-related sources in the GOM, including those directly associated with the platform facilities. The study included the Louisiana Offshore Oil Port (LOOP), drilling rigs, marine vessels, and helicopters. Pollutants covered in the inventory are the criteria pollutants—carbon monoxide (CO), NOx, SO_2, particulate matter of 10 micrometers (PM10) and 2.5 micrometers (PM2.5), and volatile organic compounds (VOC).

Non-platform sources included support vessels such as crew boats that transport workers to and from work sites, supply vessels that carry supplies to offshore sites, and tugs and barges that transport heavy equipment and supplies. Pipe laying vessels are those associated with new pipeline construction and pipeline repair. Survey vessels are used to map offshore geologic formations and seismic properties to evaluate potential oil reserves. Emissions associated with the above categories of vessels are attributed to the operation of the primary diesel engine used for propulsion and other smaller diesel engines that, depending on the vessel type, are used to run generators, small cranes and winches, air compressors and welding equipment.

Table 1 provides the emissions estimates for support vessels, pipe-laying operations and seismic surveys. Results indicate that OCS oil and gas production platform and non-platform sources emit the majority of criteria pollutants in the GOM OCS, with the exception of PM10 and SO_2, which are primarily emitted from commercial marine vessels. Support vessels were the highest emitters for NOx, accounting for 35% of the total estimated NOx emissions. The high NOx emission level likely is attributable to the number of offshore service vessels, their average speeds and their dynamic positioning capabilities.

Altogether, OCS oil and gas production platform and non-platform sources account for 93% of the total CO emissions, 74% of NOx emissions, and 76% of VOC emissions. Commercial vessels (such as those that transport a wide range of agricultural, manufacturing and chemical products through the GOM) and commercial fishing boats are non-oil/gas emission sources that are included in Table 1 for comparison to the OCS non-platform sources.

Table 1. Emissions Estimates (tons per year) of Certain OCS Source Categories in 2008 (Wilson et al., 2010).

Source Type	CO	NOx	PM10	SO_2	VOC
Support vessels	12,880	135,222	2,342	18,221	2,342
Pipe-laying operations	2,186	10,535	398	1,789	398
Survey vessels	141	1,690	26	204	26
Commercial marine vessels	6,593	79,329	6,603	49,009	2,794
Commercial fishing vessels	681	8,120	124	988	124

Although emissions from offshore service vessels may be high in some instances, the majority of such emissions are spread over an area between the offshore sites and the onshore staging points. As an illustration, the GOM OCS represents an area of 160,000 square miles, and if transposed over a similarly-sized continental region, would encompass the cities of Dallas, Houston, New Orleans, Mobile and all the towns in between. The potential for impacts from mobile sources over such a large area is significantly lower than from stationary source emissions of similar magnitude.

C. Noise Disturbances and Collisions on Species

Service vessels transmit noise through both air and water. Propeller cavitations are generally the dominant noise source on vessels. The intensity of noise from service vessels is roughly related to ship size, laden or not, and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. For a given vessel, relative noise also tends to increase with increasing speed. Commercial vessel noise is a dominant component of manmade ambient noise in the ocean and offshore service vessels comprise a minor component of this total ambient level (MMS, 2002).

Vessel collisions with marine mammals can cause major wounds and/or be fatal to the animals. All sizes and types of vessels can collide with whales but the most lethal or severe injuries tend to be caused by ships that are 80 meters (262 feet) in length or longer and those traveling 14 knots or faster. The majority of collisions appear to occur over or near the continental shelf at times when the whales are not seen beforehand or are seen too late to be avoided. Slow-moving cetaceans or those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale) might be the most vulnerable to collisions with vessels (MMS, 2002).

There is evidence to suggest that certain whales have reduced their use of areas that are also heavily utilized by ships, possibly avoiding or abandoning important feeding areas, breeding areas, resting areas, or migratory routes. Long-term displacement of animals, in particular baleen whales, from an area is a possibility. The continued presence of various cetacean species in areas with heavy boat traffic, however, indicates there is a considerable degree of tolerance to ship noise and disturbance. Although there is the possibility of short-term disruption of movement patterns and behavior, such disruptions from OCS support vessels are unlikely to affect survival or growth unless they occur frequently (MMS, 2002).

D. Release of Invasive Species

Vessels that travel to ports outside of their local regions can return with alien marine species from ballast-water discharges, hull fouling, and equipment placed overboard (e.g., anchors, seismic airguns, hydrophone arrays). Once introduced, those aquatic invasive species can displace native species and significantly affect the local ecosystems. Harmful aquatic organisms have been identified by the International Maritime Organization as a substantial threat to the world's oceans and waterways. The economic costs from invasions of non-indigenous species can run into billions of dollars annually. As an example, the European zebra mussel has infested more than 40% of US inland waterways and millions of dollars are spent each year on control and monitoring efforts. Maintenance activities by the electric-power industry on pipes clogged with zebra mussels are estimated to cost $60 million per year.

Given that the majority of support vessels in the offshore oil and gas industry are domestic and stay within their home ports (or only discharge ballast water within a single "Captain of the Port" zone), they do not pose a risk of introducing foreign species into US waters. Best management practices should be implemented on oceangoing vessels coming from foreign waters, especially mobile drill ships that remain in one locality for long periods, to minimize the transfer of aquatic nuisance species on hulls. USCG regulations at 33 CFR Part 151, Subpart D, are also intended to reduce the risk of introducing invasive species from ballast water. Those regulations apply to all vessels, with certain exceptions, that operate in waters of the US and are bound for ports or places in the US.

E. Transport of Hazardous, Explosive or Radioactive Materials

Hazardous chemicals, explosives and radioactive materials are used routinely in the offshore oil and gas industry. Shipments of those materials are highly regulated. All materials must be packaged and transported in accordance with numerous rules, including the DOT regulations found in 49 CFR; USCG regulations found in 33 CFR and 46 CFR; international maritime packaged dangerous goods code (IMDG Code); and, for radioactive materials, the International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Materials. Additionally, waste consignments also fall under EPA and state regulations and must be accompanied by the necessary waste inventory and waste characterization information.

F. Cold Environments

Due to the growth of oil and gas exploration in colder climates, there is an increasing demand for offshore support vessels built to ice class. Ships navigating in ice-prone areas can risk stressing the hull and inducing propulsion failures. New developments in ice navigation and winterization are generating a new challenge for shipping and shipbuilding industries all over the world.

The International Association of Classification Societies (IACS) requirement concerning Polar Class is a set of rules for designing and outfitting vessels for navigation in ice and polar waters. Those rules are proposed to be uniformly applied by classification societies on ships contracted for construction on and after 2012 (IACS, 2011). The IACS Polar Class requirements are being created in line with the IMO Guidelines for Ships Operating in Arctic Ice Covered Waters to provide comprehensive requirements for the safe navigation of ships in Arctic waters. Ice-class rules are categorized into various levels depending on area of operation, time of year, and service. As ice conditions and service requirements increase, so do the requirements increase for strengthening the hull, increasing the horsepower and strength of the propulsive system, toughening of the hull and superstructure steel, and providing ancillary systems that protect the crew and vessel from cold weather. Vessels that need to operate independently or as an escort of less capable vessels have more stringent requirements.

ENVIRONMENTAL EFFECTS RELATED TO AIRCRAFT

Operational data published by the Helicopter Safety Advisory Conference for 2008 (HSAC, 2009) show there were 551 helicopters in the GOM offshore fleet that carried nearly three million passengers on 1,245,770 flights. HSAC is an industry group that promotes best practices for safe flight operations, including support for oil and gas operations, and also serves as a clearinghouse for related information that complements regulatory oversight by the FAA.

A. Noise Disturbances and Collisions on Species

Noise generated from helicopters is transient in nature and extremely variable in intensity. Helicopters often radiate more sound forward than backward; thus, underwater noise is generally brief in duration, compared with the duration of audibility in the air. In addition to the altitude of the helicopter, water depth and bottom conditions strongly influence propagation and levels of underwater noise from passing aircraft. Lateral propagation of sound is greater in shallow than in deep water (MMS, 2002).

Terrestrial wildlife disturbances from aircraft noise range from mild, such as an increase in heart rate to more damaging effects on metabolism and hormone balance. Long-term exposure to noise can cause excessive stimulation to the nervous system and chronic stress that is harmful to the health of wildlife species and their reproductive fitness. Many factors influence an animal’s response to noise. These include distance to the aircraft, type of aircraft, suddenness of its appearance and the frequency of overflights. Aircraft that are closer generally are more likely to produce a response, although there is no minimum distance that has been found to produce no effects, and the responses are highly dependent on the species. Some tolerance for overflights has been observed when flights are frequent or regular but this is also not consistent among all species (NPS, 1994).

Aircraft overflights in proximity to cetaceans can elicit a startle response. Whales often react to aircraft overflights by hasty dives, turns, or other abrupt changes in behavior. Responsiveness varies widely depending on factors such as the activity the animals are engaged in and water depth. Whales engaged in feeding or social behavior are often insensitive to overflights. Whales in confined waters or those with calves, sometimes seem more responsive. That behavioral response could be a result of noise and/or visual disturbance though the effects appear to be transient, and there is no indication that long-term displacement of whales occurs (MMS, 2002).

In a study that looked at short-term behavioral responses of bowhead whales and beluga whales to a Bell 212 helicopter and a Twin Otter fixed-wing aircraft, the helicopter was found to elicit fewer detectable responses by bowheads (14% of 63 groups) than by belugas (38% of 40). For the fixed-wing aircraft, few bowheads (2.2%) or belugas (3.2%) were observed to react to overflights. When there were observed reactions by whales, most occurred when the helicopter was at altitudes of ≤ 150 m (492 ft), or ≤ 182 m (597 ft) for the aircraft (Patenaude et. al., 2002).

It is not possible to know whether animals are unaffected if they do not illicit a conspicuous response to an aircraft and it is not known whether there are subtle effects that could be biologically significant (MMS, 2002). Because of the potential for wildlife effects from aircraft noise, FAA Circular 91-36C encourages pilots to maintain higher than minimum altitudes near noise-sensitive areas and to follow flight paths that would reduce noise in such areas. Corporate policy for all helicopter companies in the GOM states that helicopters should maintain a minimum altitude of 700 feet while in transit offshore and 500 feet while working between platforms and drilling rigs. When flying over land, the specified minimum altitude is 1,000 feet over unpopulated areas and coastlines, and 2,000 feet over populated areas and sensitive areas including national parks, recreational seashores, and wildlife refuges. In addition, the guidelines and regulations promulgated by National Marine Fisheries Service require helicopter pilots to maintain 1,000 feet of airspace over marine mammals (MMS, 2002).

Bird strikes with helicopters are a misfortune for both animals and pilots because they also cost the lives of pilots and have damaged aircraft. Helicopters are particularly vulnerable to bird strikes since they fly at low altitudes and high speeds. The FAA further recognizes that large concentrations of migratory birds are a safety hazard to pilots. The routes of many migratory species cross the GOM and also occur along the coastal shorelines of the US.

HSAC has been involved in developing recommended practices (RPs) to reduce risks in offshore operations. While not regulatory in authority, HSAC RPs provide aviation and oil and gas industry operators with useful information in developing procedures to avoid certain hazards of offshore helicopter operations. HSAC-RP No. 2010-3 (published May 2010) provides guidance for pilots regarding training, diligence and operational practices that can help minimize helicopter strikes on birds.

B. Air Emissions

Emission estimates are highly variable depending on whether the helicopter is in transit or idling on the platform, the type of aircraft, and the distance travelled. The rate during idling is much higher due to the engine operating outside of its optimal range.

The draft Year 2008 Gulfwide Emission Inventory Study (Wilson et al., 2010) also estimated the amount of criteria pollutants from helicopter support operations which is another non-platform oil/gas source of emissions in the GOM (Table 2). It should be noted, however, that helicopter support operations may be underestimated because the data obtained from HSAC are voluntarily provided by a fraction of the operators and that more comprehensive data from the FAA were not yet available for the 2008 inventory.

Table 2. Emissions Estimates (tons per year) from OCS Support Helicopters in 2008 (Wilson et al., 2010).

Source Type	CO	NOx	PM10	SO_2	VOC
Support helicopters	13,636	1,114	217	275	2,693

FINDINGS

Ocean vessels and helicopters comprise two separate classes of essential transportation services for offshore oil and gas projects and both classes will be needed in their respective roles for the foreseeable future. Ocean vessels and helicopters that operate in or above the US Outer Continental Shelf (OCS) are regulated by US federal agencies that include the US Coast Guard (USCG; vessels) and the Federal Aviation Administration (FAA; helicopters). The USCG also relies on third-party “classification societies” (marine industry technical and management professional groups) for standardization and certification of certain operational characteristics of vessels. In addition, industry participants establish and promote best practices for safe helicopter operations that extend beyond the regulatory focus of the FAA.

Ocean vessels and helicopters involve different sets of potential environmental impacts. Helicopters are associated with air emissions, potential noise disturbances of birds and marine mammals and also with potential collisions with birds in flight. Ocean vessels are associated with air emissions, liquid discharges, and potential noise disturbances of marine mammals or collisions with marine mammals. In addition, ocean vessels can be associated with release of invasive (non-native) species and with disturbance of coastal waterways and wildlife habitats. Noise or potential chemical pollution from vessels is regulated by a collection of different federal regulations that are enforced by the USCG.

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Specific findings are:

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APPENDICES

A. Appendix 1: Glossary

ACP. Alternate Compliance Program.

BOEMRE. US Bureau of Ocean Energy Management, Regulation and Enforcement. As of June 2010, BOEMRE was created to succeed the former Minerals Management Service (MMS). BOEMRE itself was divided into two different agencies (BOEM and BSEE) in January 2011.

CFR. US Code of Federal Regulations.

CO. Carbon monoxide.

COI. Certificate of Inspection.

EPA. US Environmental Protection Agency.

FAA. USA Federal Aviation Administration.

GIWW. Gulf Intracoastal Waterway.

GOM. Gulf of Mexico.

HSAC. Helicopter Safety Advisory Conference.

IACS. International Association of Classification Societies.

IMO. International Maritime Organization.

MARPOL 73/78. 1978 Protocol to the International Convention for the Prevention of Pollution from Ships.

MMS. US Minerals Management Service (MMS). As of June 2010, it was replaced by the BOEMRE.

MRGO. Mississippi River Gulf Outlet.

NEPA. National Environmental Policy Act (NEPA). US federal legislation, dating from 1970, that provides for an environmental impact statement (EIS) as a core requirement of federal regulatory agencies that are responsible for permitting infrastructure projects, including oil and gas exploration and development.

NMFS. US National Marine Fisheries Service.

NOx. Nitrogen oxides (some combination of NO and NO_2).

OCIMF. Oil Companies International Marine Forum.

OCS. Outer Continental Shelf. By physiographic definition the continental shelf is the expanse of seafloor between the shoreline and the break in slope at the continental margin that defines the continental slope and the more distant benthic regions of the ocean bottom. The continental shelf varies in width and depth. For US regulatory purposes, the OCS is defined as "an offshore area in the United States that begins where state ownership of mineral rights ends and ends where international treaties dictate". The OCS includes both shallow and deepwater developments.

OPA-90. Oil Pollution Act of 1990. US federal legislation, dating from 1990, that sets requirements for oil-spill prevention and response and for penalties associated with non-compliance. It was motivated largely by the *Exxon Valdez* oil spill in offshore Alaska in 1989.

OVMSA. Offshore Vessel Management and Self Awareness.

PM. Particulate matter. Usually specified with a number designator that indicates the size (micrometers) of the particles (for example, PM10 or PM2.5).

RP. Recommended practice.

SIRE. Ship Inspection Report.

SO_2. Sulfur dioxide.

USACE. US Army Corps of Engineers.

USCG. US Coast Guard.

VOC. Volatile organic compounds.