Frequently Asked Questions About FPSO's
December 2001

What is an FPSO?

"FPSO" stands for Floating Production, Storage and Offloading. An FPSO system is an offshore production facility that is typically ship-shaped and stores crude oil in tanks located in the hull of the vessel. The crude oil is periodically offloaded to shuttle tankers or ocean-going barges for transport to shore. FPSO's may be used as production facilities to develop marginal oil fields or fields in deepwater areas remote from the existing OCS pipeline infrastructure. Additional details about FPSO's can be found in OCS Report MMS 2000-015.

Where have FPSO's operated to date?

FPSO's have been used to develop offshore fields around the world since the late 1970's. They have been used predominately in the North Sea, Brazil, Southeast Asian/South China Seas, the Mediterranean Sea, Australia, and off the West Coast of Africa. There are currently 70 FPSO's in operation or under construction worldwide. In addition to FPSO's, there have been a number of ship-shaped Floating Storage and Offloading (FSO) systems (vessels with no production processing equipment) used in these same areas to support oil and gas developments. One FSO is currently operated by PEMEX in the southern Gulf of Mexico (Bay of Campeche).

Have there ever been any major spills from FPSO's?

Several organizations have developed comprehensive databases for all offshore incidents. A study by INTEC Engineering was commissioned by DeepStar early in the environmental impact statement (EIS) process to identify the spill history for FPSO operations. DeepStar is a multiphase deepwater technology study currently funded by 16 oil companies and more than 40 contributing manufacturers, vendors, consulting organizations, classification organizations, and contractors.

The largest spill from an FPSO occurred in the late 1990's – approximately 3,900 barrels of oil were spilled from the Texaco *Captain* FPSO during startup at its field location. The spill was attributed to human error during the start-up procedure; an overboard dump valve was inadvertently left open and hydrocarbons were released. Oil spills from all other FPSO operations have reportedly spilled less than 500 barrels of oil combined. FPSO's have been successfully operating for a cumulative 460 plus FPSO-years, processing an estimated 6.4 billion barrels of crude oil.

Why did MMS require an EIS?

Out of an abundance of caution, MMS required that an Environmental Impact Statement (EIS) be done addressing the proposed use of FPSO's. The National Environmental Policy Act requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment. The use of FPSO's would represent new technology and potential impacts in the Gulf OCS. The decision to prepare an EIS was based on several considerations including the potential for significant environmental impacts, the degree of uncertainty about level of potential impacts, and the concern or controversy associated with a proposed action. There was also concern over an apparent higher risk of very large oil spills. (Subsequently, the EIS analyses and the CRA showed that FPSO's do not pose greater spill risks.) The EIS was initiated not only to evaluate potential environmental impacts, but also to provide for public

disclosure and input.

For the purposes of the EIS, how is deepwater defined?

The MMS chose the 200-meter (approximately 650-foot) isobath to represent the beginning of deepwater area for the purposes of this EIS. The MMS recognizes that deepwater is defined differently by many operators. However, in considering the water depths that FPSO's have operated in the past, we believe 650 feet is a reasonable definition for deepwater.

Why did you investigate FPSO's only for the Central and Western Planning Areas?

As industry is proposing the use of FPSO in the Gulf of Mexico OCS (the proponent of the proposed action), MMS relied on industry to identify the scope of their proposed activities. Industry indicated an interest in FPSO operations for only the deepwater areas of the Central and Western Planning Areas of the Gulf of Mexico OCS. In addition, industry indicated they did not anticipate that produced oil from any FPSO would be tankered into any ports east of the Mississippi River ports.

What was the FPSO system studied in the EIS, and how was it chosen?

The MMS and DeepStar developed the FPSO scenario to be representative of the range of typical FPSO's that would be likely to operate in the GOM during the next 10 years. Expertise representing FPSO operating companies, designers and builders, equipment manufacturers, classification society organizations, and government agencies were involved in the system definition used for the FPSO base case. The base case scenario studied in the EIS was a generic FPSO system that can be described as follows:

- permanently moored, fully weathervaning turret;
- double-hulled (sides and bottom per OPA 90), ship-shaped;
- storage up to 1 million barrels of crude oil;
- 300,000 barrels of oil and 300 million cubic feet of gas per day processing capability;
- multiple subsea wells producing back to the FPSO;
- conventional, ship-shaped, shuttle tankers with 500,000 barrel storage capabilities.

The base case investigated in the EIS addressed shuttle tankers. Why did you not consider tug-barge systems (e.g., articulated tug and barge (ATB))?

The use of a conventional shuttle tanker was identified by the industry/MMS/USCG team as the most likely scenario for an FPSO-based development in the GOM. The EIS does not exclude the use of ATB's; both shuttle tankers and ATB's would transport the oil from the FPSO to shore. The EIS addressed the potential use of ATB's as part of the range of technical options for the proposed action. In responding to comments on the draft EIS, the USCG stated that they consider an ATB to be a specialized type of integrated tug barge (ITB) and subject to policies described in the USCG Navigation and Vessel Inspection Circular (NVIC) 2-81 (Change 1). The use of ATB's is an issue that the USCG would address in their permit requirements for the FPSO-based development.

Why didn't the EIS address floating storage units?

A Floating Storage and Offloading (FSO) unit can be considered to be a subset of FPSO's. The FSO system lacks the oil and gas production processing capabilities of the FPSO. An FSO is typically used as a storage unit for production processed from other platforms that are

remote from infrastructure and lack an oil pipeline to transport the oil to the refinery. One example is the *Ta'Kuntah* FSO that has been operating in the southern GOM (Mexican waters) since 1999. The EIS provides a programmatic NEPA review of the major aspects of FPSO's and FPSO-like operations, including on-site storage of large volumes of produced oil, offloading operations, surface transport of OCS-produced crude oil, and the potential fate and effects of very large oil spills. The environmental review of an FSO proposal would be able to tier from the EIS and incorporate by reference the analyses of the aspects in common.

What is the next step now that MMS has issued the Final EIS and a Record of Decision (ROD)?

The ROD documents the Agency's decisions that are based on the EIS and is the formal completion of the EIS process. The MMS will continue to work with the U.S. Coast Guard (USCG) to delineate jurisdictional issues based on the Memorandum of Understanding between the two agencies. That Memorandum of Understanding was signed in December 1999 and addresses all OCS oil and gas activities. Discussions with USCG will continue about the potential use of FPSO's within portions of the lightering prohibited areas. There will be continued dialogue and work group activities with the industry to further enhance existing recommended practices, guidelines and standards for floating production systems (including FPSO's). The API has also commissioned a workgroup to further address concerns associated with shuttling crude oil from OCS production facilities to the tanker operations in the GOM. Both MMS and the USCG are involved in the API-led effort.

Further action on any specific FPSO proposal would proceed as with any other hydrocarbon development in deepwater. The first formal step in the proposal process would be the submission, review, and approval of a Deepwater Operations Plan. Later, the operator would submit an OCS development plan. At that time, an environmental assessment would be done to evaluate the site-specific and proposal-specific aspects of the proposed FPSO operations.

What level of review will be required if a proposal is submitted for FPSO operations that aren't like the EIS base case (e.g., a single-hulled FPSO)?

The EIS is a programmatic document that examines the concept of, and fundamental issues associated with, the petroleum industry's proposed use of FPSO's in the Central and Western Planning Areas of the Gulf OCS. The EIS addresses the proposed action generically and does not constitute a review of any site-specific development proposal. The EIS considers a range of technical variations that would reasonably be expected to represent industry's intended applications of these systems. The major components of the "base-case," a generic FPSO system and operation, generally fall within a range of potentially viable design choices and configurations. The EIS provides a programmatic NEPA review of the major aspects of FPSO's and FPSO-like operations, including on site-storage of large volumes of produced oil, offloading operations, surface transport of OCS-produced crude oil, and the potential fate and effect of very large accidental oil spills. Further technical and environmental evaluation will be required for specific FPSO proposals. The MMS will require submission and approval of a Deepwater Operations Plan (DWOP) and a Development Operations and Coordination Document (DOCD) before any FPSO operation could occur. The DOCD environmental review will be tiered off of the regional environmental analysis in the programmatic EIS and will focus on the site-specific and system-specific aspects of the proposed FPSO. Any proposed FPSO operations that are not within the range of operations evaluated in the programmatic EIS will require more extensive

environmental review and NEPA documentation than would proposed operations within the range addressed in the EIS.

What has been accomplished as a result of the EIS? The regulatory model process?

The EIS examined the range of most likely configurations of potential FPSO operations that may be proposed for use in the Gulf of Mexico OCS. The EIS provides a programmatic NEPA review of the major aspects of FPSO's and FPSO-like operations, including on-site storage of large volumes of produced oil, offloading operations, surface transport of OCS-produced crude oil, and the potential fate and effects of very large oil spills. Although the level of environmental review for a site-specific, proposal-specific development plan will depend on the final decision document in the Record of Decision (ROD) and on the specific operations proposed, the EIS was intended to serve as a base document from which to tier subsequent environmental review of FPSO's. This should allow FPSO proposals within the range of operations addressed in the EIS and conforming to any constraints imposed by the ROD to be addressed by a site- and proposal-specific environmental assessment (EA). The MMS anticipates that such an EA would be completed within six months.

Review of the Regulatory Model has resulted in an MMS-proposed regulatory package to enhance the existing rules through the incorporation of several recommended practices. A complete rewrite of the Platforms and Structures section (Subpart I) in 30 CFR 250 is one of the key parts of this regulatory package to address all floating production systems (including FPSO's). Also part of this effort is the incorporation of several recommended practices into the existing pollution prevention regulations (30 CFR 250). Publication of the MMS regulatory package (Documents Incorporated by Reference and Subpart I rewrite) was published as a Draft Rule in December 2001.

The Regulatory Model development has allowed the MMS and USCG to identify the applicable industry design and operating standards for FPSO-based developments that have been applied throughout the world. This effort has also identified where gaps exist in the design and operating standards, allowing the agencies and industry to develop appropriate strategies for closing the gaps. When competed, the regulatory model will provide industry with a road map for the approval process of an FPSO-based development on the Gulf of Mexico OCS.

During this time, the MMS funded a Comparative Risk Analysis to evaluate the risks associated with FPSO technology compared to those associated with three types of existing GOM deepwater facilities. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service were consulted on FPSO-related issues under their respective jurisdictions. The MMS sponsored and participated in several joint Federal/industry workshops to identify the technical, safety, and environmental issues and information needs related to FPSO's, as well as to gain a better understanding of FPSO technology and scope of operations around the world.

What steps remain to be taken by government and industry to complete the regulatory model and what is the timetable?

Coordination and settlement of overlapping responsibilities between the USCG and MMS are continuing. Both MMS and the USCG believe the capability (framework) exists to review an FPSO-based development. This effort has progressed to the point of determining the specific points within the production and marine systems where jurisdiction changes. The objectives of this effort are to minimize duplication of effort and to ensure a consistent regulatory review for FPSO-based developments. In addition, publication of a regulatory package by MMS

(Documents Incorporated by Reference and Subpart I rewrite) will enhance MMS's ability to regulate all floating production systems, including FPSO's, in the Gulf of Mexico OCS.

A work group comprising the Offshore Operators Committee, MMS, and USCG developed a set of recommended actions as part of a broad regulatory framework for FPSO's in the GOM. There are several outstanding recommendations affecting industry and the USCG that need to be addressed. No specific timeline has been developed by the industry to close these action items; the USCG continues to gather information and is working closely with MMS to address mutual requirements.

What was the focus for your Comparative Risk Analysis (CRA)?

Concurrent with the EIS, the MMS-funded CRA was performed to compare the relative risks of an FPSO system with three other deepwater development systems: fixed platform production hub, a spar, and a tension leg platform (TLP). All of the production systems except the FPSO are currently in use for deepwater development projects in the U.S. Gulf of Mexico. The study was performed under contract to the Offshore Technology Research Center, with technical support from EQE International and the industry consortium DeepStar. The CRA used the same base-case FPSO system that was used in the EIS. The overall intent of the CRA was to provide MMS context and perspective for FPSO risks, and to assist with MMS decisions regarding the potential use of FPSO's in the Gulf OCS. The CRA was also designed to help MMS understand the risk contributions of the various components (subsystems) and phases of operation.

How were the results of the CRA used to focus mitigation?

The CRA did not mitigate the risks identified in the study. The CRA concluded that there are no significant differences in the oil-spill risks among the four systems studied (FPSO, TLP, Spar, and Fixed Jacket Platform serving as a Production Hub/Host). The MMS and the study participants deemed it not necessary, for purposes of the CRA study, to mitigate the FPSO-based development to a lower level than the risk levels represented by the existing deepwater production systems. The CRA did include a limited effort to identify potential risk reducing measures but these were not quantitatively investigated.

The EIS and accompanying frequency analysis for accidental spills also identified potential risk-reducing measures.

Specific to the shuttle tanker transport, what were the data sources used in the EIS accidental spill frequency analysis and the CRA?

Det Norske Veritas (DNV) performed the "Accidental Spill Frequency Analysis" for the EIS. The data set used to determine the frequency of shuttle tanker spills was based on data from Anderson and LaBelle (1994) for spills in U.S coastal and offshore waters. The data cover tanker spills over a 19-year period (1974-1992). Spill size distribution was based on an analysis by DNV of data from Lloyd's Maritime Information Service (LMIS) database for worldwide tanker spills over a 3-year period (1992-1994).

In the CRA, risks (both for spills and fatalities) were extrapolated directly from historical experience in the GOM, using MMS and USCG databases whenever possible. The study started with raw data sets that were as complete as possible in the preliminary risk assessments, and refined the data so they were relevant predicting the future performance of the FPSO in the GOM. For example, the frequency of shuttle tanker spills of less than 10,000 bbl is based on the

USCG data for crude oil tanker spills occurring in the Gulf of Mexico. These data were refined to account for the benefits demonstrated to date and expected to occur as a result of OPA 90 (i.e., the data used are from 1992-1999). For spills greater than 10,000 bbl, the CRA used post-OPA 90 data for crude tankers worldwide. Likewise, the spill risks from process systems onboard the various deepwater production systems were based on incidents that occurred after 1990. Incidents prior to 1990 were discarded because of the implementation of MMS regulations in 30 CFR 250, specifically the incorporation of standards such as API RP 14B, 14C, and 14H. These standards address the design and operation of the safety devices installed to protect both personnel and the environment.

MMS appears to have used separate data sets for the risk studies done in the EIS and the CRA. Why was this done?

See previous comment. Separate consultants performed the Accidental Spill Frequency Analysis (EIS) and the Comparative Risk Analysis (DNV for the EIS; the Offshore Technology Research Center (OTRC) for the CRA). As noted above, the data used by DNV were proprietary data not accessible to the CRA. Further, it was decided by OTRC and expert participants in the CRA to discard incidents prior to the implementation of OPA 90, thereby reflecting the current requirements for an FPSO operating in the OCS. The MMS believes that the datasets used were appropriate for their applications.

Are there plans for updating the NEPA analysis and the Comparative Risk Analysis?

The scenario for the EIS addresses a 10-year time frame from 2000-2010. The MMS believes the scenario is representative what is likely to occur regarding FPSO operations during this time. The MMS will use each site-specific Development Operations Coordination Document (development plan) application and its accompanying environmental information to update the NEPA analysis provided by the programmatic EIS. In addition, MMS will include evaluation of FPSO's in future lease sale EIS's.

The MMS is considering a follow-up study to the CRA to investigate alternative hulls (e.g., Spars) used as FPSO's. Data collection and experience with actual FPSO's and other deepwater systems will provide the opportunity to refine some of the results in the CRA, thereby reducing the level of uncertainty identified in the study. (On many of the CRA graphics, error bars show the range of uncertainty).

What systems or operations were identified as having the highest risk of a large pollution event?

Oil transportation, regardless of the type of deepwater production facility, was identified through the various programmatic studies as having the highest risk for a spill. The oil transportation systems include pipelines for Spars, TLP's, and fixed platforms; and shuttle tankers for FPSO's.

Are there FPSO systems, subsystems, or technical issues that MMS has identified as having a higher leak frequency or risk to operational safety? If so, how will these be addressed?

The risk studies and other technical evaluations have been performed as part of MMS's strategy to support a decision about the acceptability of FPSO's for OCS development in the deepwater Central and Western GOM. Both the EIS and the CRA found the transportation system to have the highest risk component, not only for FPSO's, but for all deepwater development systems. There are systems unique to FPSO-based development that will require

technical evaluation when a site-specific application is submitted. Two examples are the turret mooring system and the equipment used to transfer produced-fluids from the seafloor production equipment to the FPSO.

The turret transfer system provides the ability for an FPSO to weathervane (that is, allowing the ship to take the position of least resistance based on wind, waves, and currents) around the mooring, thus minimizing the loading imposed by the environment. Two designs have been used for transferring hydrocarbons and utilities (control fluids, etc.) from the risers to the piping on the deck of the FPSO mooring system: a swivel system that allows production from the subsea wells to be transferred to a freely weathervaning ship, and a drag-chain system. The reader is referred to MMS 2000-015 for details of the two systems

A key component of MMS's ability to review an FPSO-based development, and in particular the unique systems associated with an FPSO, is the Deepwater Operations Plan (DWOP). Notice to Lessees (NTL) 2000-N06 describes the DWOP requirement. The DWOP addresses MMS's review of the deepwater development project from a total system perspective without writing new regulations, i.e., using the existing regulations that provide for the use of alternative compliance measures. The information required to be submitted in a DWOP focuses on characterizing the production system on a component basis, including the following: structural aspects of the facility (fixed, floating, subsea); stationkeeping (includes mooring system); wellbore, completion, riser systems; safety systems; offtake; and hazards and operability of the production systems. By design, the DWOP is able to look at the components of a proposed development system to see how they relate to previously approved production systems. Information is gathered for the individual components of the various types of deepwater production systems and integrated into a review that is focused from a total systems perspective. The DWOP also provides the mechanism for MMS to move forward with actions on a development project even though all the technical issues have not been completely identified or resolved. The DWOP provides MMS with the ability to determine that the operator has designed and built sufficient safeguards into the production system to prevent the occurrence of significant safety or environmental incidents.

When do you expect the first application for an FPSO-based development to be submitted?

To date, no lease operator has approached MMS with plans to develop an OCS discovery with an FPSO. The GOM operators have made it clear that the FPSO is a system they believe is necessary to enable the development of some Gulf of Mexico OCS leases. They have further indicated that not all discoveries will be candidates for FPSO-based projects. As operators continue to make discoveries far away from existing infrastructure, and find economically marginal fields, the FPSO will likely be a development system that is given serious consideration.

How long will it take for MMS to review the permits for an FPSO-based development?

Early dialogue between MMS and the operator and complete information submittal are key to avoiding delays that might affect project start-up plans. Further technical and environmental evaluation will be required for specific FPSO proposals. The MMS will require submission and approval of a Deepwater Operations Plan (DWOP) and a Development Operations and Coordination Document (DOCD) before any FPSO operation could occur. The EIS provides a programmatic NEPA review of the major aspects of FPSO operations, including on-site storage of large volumes of produced oil, offloading operations, surface transport of

OCS-produced crude oil, and the potential fate and effects of very large oil spills. The environmental review of an FPSO proposal would be able to tier from the EIS and incorporate by reference the programmatic analyses. The MMS projects that it will take 6 to 9 months to complete the environmental review and take action on a Development Operations Coordination Document (referred to as a DOCD) for a proposed FPSO within the range of activities evaluated in the EIS. Any proposed FPSO operations that are not within the range of operations evaluated in the programmatic EIS will require more extensive environmental and technical review to demonstrate equivalence to what was investigated by MMS.

The technical permit requirements would be closely tied to key milestones in the operator's development schedule. The DWOP timing can be summarized as follows:

- 30 days for Conceptual Part of DWOP;
- up to 90 days for Preliminary Part of DWOP.

Will MMS allow gas to be flared or reinjected?

The MMS will require the operator to transport produced gas to market. This will likely require a dedicated pipeline for gas production. The MMS has stated throughout the development of the FPSO strategy that flaring of gas would not be permitted on an extended basis. The MMS regulations do provide some limited volume, short duration flaring upon approval.

Although gas may be injected to increase ultimate oil recovery, MMS has stated that reinjection of the produced gas would generally not be permitted without a commitment from the operator to produce the gas at a later time. Although it is possible for another lessee to produce injected gas at a later date, it is highly unlikely that after the oil has been depleted another operator could economically recover the gas if the original operator couldn't at the time the oil was produced. A policy that permitted gas injection without a commitment to later produce the gas would result in a tremendous loss of mineral resources to the United States.

There are emerging technologies for converting gas to liquids, gas compression for ship-born transport, etc. that have been identified in industry studies as technically and economically feasible. The MMS believes these alternatives must be considered in decisions about gas disposition.

Has there been a ruling from the U.S. Customs Service regarding the applicability of the Jones Act to FPSO's and shuttle tankers involved in OCS development?

The USCG received a response from the Customs Service dated March 7, 2001. The response states that shuttle tankers must comply with Jones Act requirements and be coastwise qualified. The Customs Service states that an FPSO permanently-moored at an OCS location would not be required to be coastwise qualified. If the FPSO is used to transport oil or natural gas to a U.S. port or a deepwater port located on the OCS (e.g., LOOP), then it must be coastwise qualified.

Could an operator transport the oil produced from an FPSO to a foreign location?

The OCS Lands Act Amendments of 1978 (43 USC 1354, Section 28) states that "any oil or gas produced from the outer continental shelf shall be subject to the requirements and provisions of the Export Administration Act of 1969." That law prohibits the export of OCS oil unless the President of the United States publishes an express finding that such exports will not increase the reliance on imported oil and gas and are in the national interest.

Are FPSO's reviewed in the programmatic EIS similar to the P-36 facility that recently sunk off the coast of Brazil?

There are many different types and configurations of floating production facilities. FPSO's reviewed in the programmatic EIS are ship-shaped-type facilities while the P-36 that recently sank off Brazil was a semi-submersible-type facility. Each FPSO proposal will be reviewed separately. Information gained from the P-36 tragedy and other offshore incidents will be factored into these reviews. Revisions to MMS rules and industry technical standards will also incorporate lessons learned from offshore incidents.