Abstract
The oil and gas production industry has expressed an interest in being able to utilize Floating, Production, Storage and Offloading (FPSO) units as a development option in the deepwater areas of the United States (U.S.) Gulf of Mexico (GOM) outer continental shelf (OCS). Operators will need regulatory approval from both the United States Coast Guard (USCG) and the Minerals Management Service (MMS) for a FPSO project. Neither the USCG nor MMS currently have regulations specifically for the design and operation of FPSOs on the OCS. A workgroup was formed under the Offshore Operators Committee’s Deepwater Subcommittee to assist MMS and USCG in reviewing the existing regulations and body of standards, specifications, recommended practices and classification society rules and guides concerning the design and operation of FPSOs on the OCS for the Gulf of Mexico. The effort also aimed to identify gaps in the regulations and industry standards. This paper provides a summary of the major findings of the workgroup. In addition to the items discussed in this paper, the workgroup report identified other areas where additional modifications to regulations or industry standards may be warranted.

Introduction
As operators have moved into the deeper waters of the GOM over the last several years, interest has been growing in potentially utilizing FPSOs as a development option to the floating production systems (tension leg platforms (TLP), spars, etc) and subsea tie backs to either floating production systems or fixed platforms that are currently being utilized. In discussions with MMS and USCG, it became apparent that several studies would need to be conducted to confirm the acceptability of these systems for the GOM. MMS indicated that an Environmental Impact Statement (EIS) would be prepared for the first FPSO proposed to be utilized in the GOM. In working with industry, MMS agreed to do a programmatic EIS on the generic use of FPSOs in the GOM if industry would fund the study. The joint industry project DeepStar agreed to fund the EIS. The draft EIS on the Proposed Use of Floating Production, Storage and Offloading Systems on the Gulf of Mexico Outer Continental Shelf in the Western and Central Planning Areas was published in August 2000 for comment. The final EIS is expected to be published in the first quarter of 2001 with a Record of Decision to be published no earlier than 30 days from the publication of the final EIS.

The second study effort was to do a comparative risk assessment to evaluate and compare oil spill and fatality risks for the FPSO with a spar, a TLP and a shallow-water jacket serving as a hub and host to deepwater production. The Offshore Technology Research Center completed that study for MMS.

The third step in the process was to identify any gaps in the existing regulations and to develop a regulatory model that could be used by MMS and the USCG in the review and approval of a FPSO project. On March 22, 2000, Mr. Chris Oynes, MMS GOM Regional Director, sponsored a meeting between MMS, USCG and industry to discuss the regulatory requirements for FPSOs in the GOM, should they be found to be an acceptable development option. Although it was recognized that MMS and the USCG would have to agree among themselves the appropriate regulations and regulatory split between the two agencies, they agreed that it would be beneficial and appropriate to have industry provide input on the model. It was decided that a workgroup would be formed under the direction of the OOC Deepwater Subcommittee and consists of industry representatives and classification society representatives along with personnel from MMS and the USCG. A report was prepared by the workgroup and submitted to MMS and the USCG in September 2000 for their consideration.

Regulatory Model Workgroup
Goal
The overall goal of the workgroup was to review the existing regulations and industry standards covering the design, construction and operation of FPSOs in the GOM and identify
any gaps in either the regulations or standards that needed to be addressed prior to bringing FPSOs into the GOM. The workgroup was focused on the design and operational considerations for the FPSO. The work group did not address the design of shuttle tankers or operational considerations once they were disconnected from the FPSO.

Participants
The workgroup was formed under the direction of the OOC Deepwater Subcommittee and met five times following the initial meeting. It was agreed that a cooperative effort with open discussions between the regulatory agencies and industry was desired and would produce the best work product. Due to the broad scope of the discussions, it was necessary to include a large number of participants. MMS agreed to have Mr. James Regg, Section Chief, Technical Assessment and Operations Support serve in the workgroup along with support from other MMS personnel. LCDR Bill Daughdrill from the Eighth USCG District represented the USCG in the work group. Personnel from the MMS Headquarters and USCG Headquarters groups were kept informed of the workgroup’s activities through e-mail. Twenty-five persons representing 17 companies participated in one or more of the meetings. Since classification societies have historically played a large role in the approval of FPSOs worldwide, it was felt that it was important to have broad representation from the major classification societies who currently class FPSOs. Four classification societies; American Bureau of Shipping, Bureau Veritas, Det Norske Veritas and Lloyd’s Register of Shipping were represented in the workgroup. Tim Sampson represented the American Petroleum Institute (API). Wanda Parker agreed to chair the workgroup for OOC. A complete listing of all workgroup participants is in the workgroup report. All of these individuals dedicated a considerable amount of time and expertise to this effort.

FPSO Characteristics
For consistency, the workgroup decided to use the FPSO characteristics used in the EIS and CRA studies as the FPSO model for this effort. The workgroup considered the regulations that would apply to a US flag FPSO or an undocumented FPSO that is designed to US flag requirements (similar to the existing GOM floating production systems). Limited discussions were held on the differences in permitting a US flag FPSO and a foreign flag FPSO. The FPSO was considered to be ship-shaped with limited discussions on the differences between a ship-shaped FPSO and a non ship-shaped FPSO. Discussions were limited to a permanently moored FPSO for simplicity since a disconnectable FPSO introduces many complicating factors into the discussion. Finally, discussions were focused on systems that are unique to FPSOs with only limited discussion of systems that are common to fixed platforms or other floating production systems. This list of system includes:

1. In Hull Cargo Storage Systems
2. Cargo Piping and Transfer
3. Turret/Mooring/Stationkeeping/Swivel
4. Propulsion
5. Stability
6. Motions/Global Performance
7. Risers
8. Offloading Systems
9. Layout
10. Operational Considerations
11. Discharges
12. Manning

Regulations
MOU
It is recognized that both MMS and USCG have a large body of regulations that could be applied to FPSOs. In the Memorandum of Understanding (MOU) between MMS and USCG signed on December 16, 1998, the delineation of jurisdictions regarding floating production system components, operations and issues is addressed. The workgroup reviewed the MOU for completeness in coverage of systems on a FPSO and put together a table showing the applicable regulations, industry standards and classification society rules for each system and sub-system in the MOU. While this table was not exhaustive, it quickly pointed out areas where regulations and standards were well established and systems where either regulations or standards were lacking. The work group made some specific recommendations concerning the implementation of the MOU that will be discussed below.

MMS
MMS regulations that are applicable to FPSOs are primarily located in 30 CFR 250, Subparts H and I. In conjunction with their regulations for specific systems, MMS has said that they intend to utilize the Deepwater Operations Plan (DWOP) process in their review of a FPSO project. The workgroup reviewed the MMS regulations for adequacy and made some specific recommendations that will be discussed below.

USCG
The USCG has said that FPSOs will be regulated as vessels and therefore will be required to meet specific vessel design and operational regulations. USCG regulations that are applicable to FPSOs are primarily located in 46 CFR, Subchapters D and IA and 33 CFR Subchapter N. On Dec 7, 1999, the USCG published a Notice of Proposed Rulemaking for 33 CFR Subchapter N that includes proposed regulations applicable to FPSOs. The workgroup considered these proposed regulations in addition to the established regulations. The workgroup report was submitted to the record as a comment to the proposed regulations. The specific recommendations will be discussed below.

Industry Standards
Both USCG and MMS regulations incorporate by reference a large number of industry specifications and recommended practices, particularly API documents. Many of these are applicable to FPSO system design or operation. In addition,
there are a host of other international standards that may be applicable to FPSOs. Most of these standards cover individual systems or subsystems that may be used in conjunction with a wide variety of types of installations. It was outside of the scope of the workgroup to conduct a thorough review of the adequacy of the individual industry specifications and recommended practices. Rather, the workgroup focused on a few key standards and made recommendations of standards the agencies should consider incorporating by reference.

**Classification Society Rules and Guides**

Another body of standards applicable to FPSOs and recognized worldwide are those developed and applied by a number of the major classification societies. The rules and guides of the societies are utilized in assessing the fitness-for-purpose of FPSOs and are focused on safety aspects. The classification requirements address design requirements as well as those for fabrication, installation, and commissioning.

Unlike the snapshot nature of certification, classification is an ongoing process by which the societies survey a FPSO periodically during its operational life to ensure compliance with the rules. Given their unique independent role internationally, classification societies are also often delegated statutory responsibilities by flag and coastal state authorities to act on behalf of the administration. USCG has, to varying degrees, delegated to several classification societies approval responsibilities for existing GOM floating production units. Expectations are that similar delegations will be forthcoming as experience is gained in GOM FPSO applications. Several classification societies have also been active to varying degrees in the MMS Certified Verification Agent program for existing structures, which may also be extended to FPSOs. The relevant practical experience from classification and statutory responsibilities is utilized in maintaining the rules and guides in a current and relevant form. The four participating societies contributed citations to the regulatory matrix for the most prevalent rule and guide requirements applicable to the various aspects of the FPSO.

**Gaps and Recommendations**

During the review process, the workgroup identified a number of recommendations either for ways to close existing gaps in the regulations or for additional work that should be considered. These recommendations were broken out into areas for consideration by MMS and USCG and for industry.

**MMS**

In 30 CFR 250, Subpart I, MMS has established a platform verification program requiring a third party certification of the platform design. These regulations were established for fixed platforms, but MMS has been applying them to floating production facilities. It is recommended that MMS revise these regulations to update them for floating facilities, including FPSOs. The workgroup recommended adding the turret, risers and mooring systems to the verification program.

In lieu of the agency writing prescriptive regulations for FPSOs, the workgroup recommended that MMS consider incorporating by reference additional industry standards and recommended practices as they become available. The following were identified as candidates for MMS review and consideration for incorporation in their entirety:

1. API RP 2FPS, Planning, Designing and Constructing Floating Production Systems
2. API RP 2SM, Design and Analysis of Synthetic Moorings
3. API RP 2SK, Design and analysis of Stationkeeping Systems for Floating Structures
4. API RP 2RD, Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs)
5. API Spec 17J, Specification for Unbonded Flexible Pipe

**USCG**

On December 7, 1999, a Notice of Proposed Making was published revising 33 CFR, Subpart N. In that revision, both Mobile Offshore Drilling Unit (MODU) regulations located in 46 CFR, Subchapter I-A and tank vessel regulations located in 46 CFR, Subchapter D were referenced. However, the regulation was not clear in many cases which regulation should be followed if both regulations cover the same system or subsystem. Also, in many cases, modifications to these regulations may be needed to address the unique circumstances of FPSO or floating system operations versus a tank vessel or MODU. The workgroup recommends that specific regulations for floating facilities should be written in lieu of pointing to regulations for various types of vessels, which may not be completely applicable to floating production facilities. The workgroup also recommended that their report be included in the comment record for the proposed rulemaking.

The workgroup recommended that marine crew manning and qualification regulations should be codified for FPSOs and for other floating production systems. The Eighth Coast Guard District has issued a policy letter for marine crew manning for floating production systems other than those storing oil in bulk, which could serve as an appropriate starting base for non-self propelled FPSOs. It was recognized that self-propelled FPSOs would need additional consideration.

MMS has adopted API RP 500/505 for area classification while the USCG has prescriptive regulations in 46 CFR, Subpart I. The workgroup recommended that the USCG adopt API RP 500/505 for floating production systems including FPSOs. Adopting common standards would minimize confusion and duplication of effort for industry since both agencies have jurisdiction for area classification.

Although the USCG has been given sole jurisdiction over fire fighting systems for floating production systems, including FPSOs, the USCG has not yet proposed regulations for fire fighting systems in the production area. It is recommended that the USCG adopt fire-fighting regulations for the production area.
Both MMS and USCG have voluntary safety management system programs that could be applicable to FPSOs. MMS has recognized API RP 75 as an acceptable basis for a safety management system for fixed and floating production systems on the US OCS. Most oil and gas production companies have based their safety management programs for operations on the US OCS on API RP 75. However, the USCG has recognized the International Safety Management Code (ISM), which is applicable to vessels that must comply with Chapter IX of SOLAS. While both programs have merit, and individual companies may want to base their programs on either standard, a combination of the standards or some other standard, the workgroup recommends that the USCG recognize API RP 75 as an acceptable basis for a safety management program in addition to ISM.

In the event that foreign flagged FPSOs are acceptable for use in the GOM, the USCG will issue a Letter of Compliance (LOC). Since a full design review is not normally conducted for a LOC, the workgroup recommended that the USCG develop a LOC checklist that could be either used with existing foreign flagged FPSOs or new-built foreign flagged FPSOs proposed for operations in the GOM.

Although the USCG has general lightering regulations and additional operational regulations that apply to the designated lightering areas in the GOM, there are no specific operational regulations that apply to FPSOs or to tandem offloading. It is recommended that a work group be formed to review existing international standards to determine their adequacy for GOM operations.

**Joint MMS and USCG**

In the MOU, both MMS and USCG have been given jurisdiction for reviewing and approving the design of the turret and mooring system. The workgroup agreed that technology is rapidly evolving for these systems and that it would be burdensome on the regulatory agencies to have personnel fully knowledgeable about these systems as they change. It is recommended that a verification agent acceptable to both agencies be selected to review and certify the design.

In the MOU, both MMS and USCG have been given jurisdiction for reviewing and approving various portions of the integrated monitoring and safety systems. It is recommended that a work group consisting of representatives of Industry, MMS and the USCG be formed to address the integration of these systems.

In the MOU, both MMS and USCG have been given jurisdiction over piping systems. It is recommended that for cargo tank piping that the specification break between MMS and USCG jurisdiction occur at the 1st valve downstream of the last processing vessel (and its control valves and safety system) prior to the oil entering the cargo storage tanks. It is recommended that a work group be formed consisting of representatives of industry, MMS and USCG to review other similar systems and agree to where the specification breaks between the systems should occur. These breaks should be codified into the MMS and USCG regulations. Alternatively, MMS and USCG should consider adopting consistent industry standards for piping systems.

Neither MMS nor USCG regulations address integral hull tanks used as process vessels (such as wet/dry oil tanks). The work group recommended that all integral hull tanks be under USCG jurisdiction for structural design. For tanks used as process vessels, the safety system, control valves, and piping to and from the process vessels should be under MMS jurisdiction. It is recommended that piping specification breaks should occur at the first flange outside the tank.

**Industry**

Both the Environmental Protection Agency (EPA) and the USCG have regulations concerning discharges to the ocean that could occur from FPSOs. It is recommended that a work group under the OOC Deepwater Subcommittee be formed to review the overboard discharge regulations of both agencies to ensure that all discharges are adequately addressed for FPSO operations.

Although the USCG has regulations that provide for the inspection of foreign flagged tank vessels, no formal determination has been requested or received from US Customs that indicates if foreign flagged FPSOs will or will not be allowed to operated on the OCS (i.e. Will Customs interpretation and policy for foreign flagged FPSOs be similar to their current interpretation and policy for foreign flagged MODUs?) The workgroup recommended that industry develop a strategy for obtaining a formal, written determination from Customs.

It was recommended that the various API standards and recommended practices for mooring systems and riser design be reviewed to determine if the inspection guidelines given in those documents are adequate for floating production systems and updating the documents as needed.

It was recommended that API RP 14C be reviewed and revised if needed for floating production systems, including taking into account the effect environmentally induced motions may have on the safety and monitoring systems. In addition, it is recommended that the safety and monitoring systems for swivels, integral hull tank process vessels and other unique systems to a FPSO be covered in the recommended practice.

It was recommended that API RP 14E be reviewed for adequacy and updated as needed for the effects of motion and piping support.

It was recommended that the various API documents on composite materials should be reviewed for adequacy for floating facilities including FPSOS.

It was recommended that API RP 75 be reviewed and updated as needed to ensure the document is an adequate basis for a safety management system for FPSO systems and operations. Applicable portions of ISO 9000/14000 could be incorporated, if desired.

The work group recognized that standards for cargo tank cleaning for FPSOs might be different from trading tankers since inspections may occur when the FPSO is on location and in operation and not in dry dock. It is recommended that appropriate standards for cargo tank cleaning be confirmed.
Conclusions
While neither MMS nor USCG has regulations that specifically apply to the design or operation of FPSOs, there is a multitude of regulations that are applicable to FPSOs and with the modifications indicated in the work group’s recommendations, the existing framework is adequate. A large body of industry recommended practices and standards consisting of classification society rules and guides, API standards, specifications and recommended practices and international standards exist that cover FPSO system design and operation. In some cases these need to be reviewed and updated, where needed, to ensure they are applicable to GOM FPSO operations. Many of the recommendations identified for FPSOs are also applicable to other types of floating facilities.

The majority of the discussions by the workgroup focused on systems that are unique to FPSOs. The FPSO model used for the discussions was a ship-shaped permanently moored FPSO. It is recognized that a FPSO is not dependent on shape and some variations occur as you move between ship-shaped and non-ship-shaped FPSOs that will need additional attention. Likewise, a disconnectable, self-propelled FPSO has many aspects that are different from a permanently moored FPSO that will need to be considered.

The review of the existing regulations was conducted without representation from the USCG Marine Safety Center or Headquarters groups. These groups need to be fully engaged before final determinations can be made on the appropriate regulations for FPSO design and operations. The representatives from the Eighth Coast Guard District participated fully in the discussions, but it was recognized by the workgroup that they were not authorized to speak definitively on USCG policy or regulation.

OOC appreciated the opportunity to take the lead role in this cooperative effort between MMS, USCG and Industry. By working together and pooling our thoughts and ideas, regulations that meet the needs of all concerned can be put in place for FPSOs in the GOM. A large number of industry representatives and classification society representatives dedicated a considerable amount of time and expertise to this task. The efforts of Mr. Jim Regg and LCDR Bill Daughdrill were recognized for their active participation in the work group. As policies and rulemaking for FPSOs are drafted, continuing the cooperative effort between the regulators, industry and the classification societies will be beneficial.

Acknowledgments
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References
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