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SAFETY INFORMATION AND MANAGEMENT ON THE OUTER CONTINENTAL SHELF

Committee on Outer Continental Shelf Safety Information and Analysis

Marine Board
Commission on Engineering and Technical Systems
National Research Council

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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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PREFACE

In 1981, the Marine Board of the National Research Council completed a comprehensive assessment of the safety of the technologies and regulations pertaining to outer continental shelf (OCS)* oil and gas development. An important area of study was safety information because without a strong safety information component in the OCS regulatory program, it is not readily possible for the government to identify safety problems and courses of action (National Research Council, 1981). In response to this concern, the Minerals Management Service (MMS) requested in June 1982 that the Marine Board provide an analysis of OCS safety information systems, including the types of information to be collected, analytical processes for utilizing data, and techniques for maximizing compatibility with other information systems.

The Commission on Engineering and Technical Systems of the National Research Council convened the Committee on OCS Safety Information and Analysis under its Marine Board. Members of the committee were selected for their experience in risk analysis, system safety, marine industrial safety, OCS industrial safety programs, OCS regulations and industrial compliance strategies, protection of the marine environment, and the environment of the heavy industrial workplace. Consistent with the policies and procedures of the National Research Council, obtaining an appropriate balance of perspectives was an important consideration in choosing committee members.

SCOPE OF STUDY

The charge to the committee was to recommend an approach to safety information acquisition, analysis, and utilization that meets management needs. The committee was to review the safety management systems

*The OCS is that portion of the submerged continental margin that is subject to U.S. jurisdiction. For the purpose of this report, the OCS extends from a state's offshore boundary (3 miles offshore except off Texas and west Florida where state boundaries extend 3 leagues -- 9 nautical miles--offshore) out to the limit of economic exploitation.

of the MMS to provide the background and framework for its recommendations. The committee also was instructed to identify the essential elements of safety management, to review the safety management activities of the MMS, and to assess the role and use of safety information in the MMS.

The committee concentrated its assessment on areas where improvements in safety information or information management practices could lead to improvements in OCS safety management by industry, or government, or both. The committee was not to identify safety problems, but to focus instead on the definition and assessment, and development and management of information systems to meet management needs. In this regard, the committee considers the National Research Council's 1981 report, Safety and Offshore Oil, to be a comprehensive review of OCS safety. The assessments and findings in Safety and Offshore Oil that are within the scope of the current committee are hereby incorporated by reference.

The scope of the committee's activity was set by the scope of the Minerals Management Service's interests, which are concentrated on OCS oil and gas drilling and production, and some aspects of pipelines. These activities do not represent the entire spectrum of OCS activity, which includes aircraft and boat operations. This limitation has certain other implications: the full range of OCS safety interests, e.g., health, are not included; the OCS safety management and information activities of other agencies, i.e., Coast Guard, Environmental Protection Agency, and Occupational Safety and Health Administration, are examined solely from the standpoint of their interface with the MMS.

The committee defined certain terms at the outset. Safety comprises the safety of workers, the environment, and of equipment and structures. Management systems refers to the organization of decision-making. Information systems refers to data collection and development, its maintenance in data bases, and its analysis. Safety information consists of data reports, analyses, and statistics concerning unplanned or unexpected incidents relating to environmental damage, bodily injury or death, or property damage.

CONDUCT OF STUDY

The committee reviewed a variety of background materials. This included: comprehensive reviews of OCS safety (National Research Council, 1981), studies of safety in the nuclear power industry (Miller, 1980), an analysis of the costs and benefits of Minerals Management Service regulations (Arthur D. Little, Inc., 1982), treatises on industrial and system safety, and descriptions of major corporate safety systems (see Appendix D), all to identify the elements normally considered important in safety systems.

The programs, files, and data bases of the MMS were reviewed to identify those that relate to safety management. The adequacy of this subset was then assessed in terms of the essential elements of safety management identified by the committee. The committee also conferred with officials of the MMS, Coast Guard, Occupational Safety and Health Administration, and Environmental Protection Agency regarding the status of OCS safety management and information systems.

The committee visited an OCS drilling operation and a production operation, together with MMS inspectors who conducted mock inspections. A meeting convened at the Gulf of Mexico regional headquarters of the MMS provided an opportunity to review regulatory procedures and compliance methods with agency staff. Also at this meeting, the committee received a presentation on the industrial safety program of one of the OCS operating companies (see Appendix D).

The committee's conclusions and recommendations are provided in the summary chapter. They are based on committee activities and the professional experience of committee members.

1. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The U.S. government has promoted and managed the development of the oil and gas resources of the outer continental shelf (OCS) since 1947. Through regulations and other management activities, the Minerals Management Service (MMS) of the Department of the Interior assembles and maintains a wealth of engineering and other data on OCS oil and gas operations for a number of purposes -- administration, royalty collection, and safety. The relation between specific kinds of information and their use by the government is not always clear. Some kinds of basic safety information are not gathered by the MMS on a regular basis. Without basic data, it is impossible to assess the safety of OCS operations or to fully develop procedures for its improvement. In a comprehensive review of OCS safety completed in 1981, the National Research Council (NRC) concluded, "Without a strong safety information component in the OCS regulatory program, it is not readily possible for the government to identify safety problems and courses of action," (National Research Council, 1981).

In response to this concern, the MMS requested in June 1982 that the National Research Council provide an analysis of OCS safety information systems, including the types of information to be collected, analytical processes for utilizing data, and the techniques for maximizing compatibility with other information systems. The Commission on Engineering and Technical Systems of the National Research Council convened the Committee on OCS Safety Information and Analysis under its Marine Board, with the charge to identify the essential elements of safety management, review the safety management activities of the MMS, and assess the role and use of safety information in the MMS. The committee undertook to assess (1) the role, organization, and activities of the MMS in promoting and assuring the safety of oil and gas operations on the OCS; and (2) the importance of safety information and its management, i.e., acquisition, analysis, and use by the MMS in OCS safety.

This chapter presents the committee's summary, conclusions, and recommendations. In conducting its assessment, the committee gathered data concerning OCS safety management and information systems, and presents its observations concerning those in this report. The recommendations made here flow from the report and the appendices.

SAFETY MANAGEMENT

The existence of safety in an organization is related to a positive safety attitude. Such an attitude cannot exist without top management leadership, and is engendered by a safety management program (see Appendix A). A logical approach to "government regulation" of safety is for the regulatory body to look closely at the management of the organization which it is regulating, and encourage safe management practices through the industrial management systems.

The government's role in OCS activities is to act as the custodian and manager of OCS resources, to motivate industry to conduct operations safely, to disseminate information, and to foster the development and application of technology that will improve the safety of OCS operations.

The Minerals Management Service promulgates and enforces regulations about leasing and operations on the OCS, including the safety of life, property, and the environment. The 1978 amendments to the Outer Continental Shelf Lands Act (OCSLA) provide the Coast Guard with additional specific authority to regulate the safety of working conditions on the OCS including conditions on marine installations. The Coast Guard has broad statutory authority to regulate maritime safety (i.e., on floating installations).

The MMS traditionally has limited its direct authority to the operator/lessee. Although much work on the OCS is done by contractors, including the vast majority of drilling operations, MMS has no contact with these companies, either in directing them how to operate or in obtaining safety or other kinds of information from them.

By limiting its authority to the operator/lessee, MMS has a disadvantage in its efforts to motivate industry to conduct safe operations or to obtain basic safety data, such as the number of OCS workers and man-hours worked. Although the law clearly places the ultimate responsibility for all offshore operations with the lessee/operator, the committee believes that MMS could choose administratively to request information necessary for safety management from contractors, and to work directly with contractors to promote safety. In this regard, the committee acknowledges that contractors run the gamut from prime contractors, such as drilling contractors, whose supervisors are in direct control of OCS operations, to subsidiary contractors with limited discretion or effect on safety offshore. The MMS should target its efforts with contractors to areas where there are significant safety problems, and where contractors exercise significant control over the safety of operations or work performance.

Although the various federal agencies with jurisdiction on the OCS have different responsibilities and administrative tasks to fulfill, overlap occasionally occurs between them. In these cases, memoranda of understanding (MOUs) are used to clarify roles and resolve any difficulties. Gray areas still remain, however, and as a result, duplication can be found in areas of inspection and accident reporting.

The MMS limits its concern for, and regulation of, workplace safety to a strict definition of the workplace -- the immediate location of drilling or production equipment. The broader aspects of workplace safety, such as habitation offshore, is exluded under this definition.

In general, when there is an artificial division or definition of responsibilities, there may be a problem of the interface of the responsibilities (possibly addressed by neither agency), which can have adverse safety implications. The concept of a single lead agency for safety is paramount for safety information reporting and for safety management. The committee concluded that the Minerals Management Service should assume coordinating responsibility, since it already has major responsiblity on the OCS. This is consistent with the OCS Lands Act amendments, which authorize the MMS to assure that inconsistent or duplicate requirements are not imposed by the various federal agencies.

Recommendation

The Minerals Management Service should exert more effective leadership of the government's OCS safety program by:

- Coordinating the efforts of regulatory agencies to eliminate inconsistent or duplicate requirements.
- Coordinating the establishment of an OCS-specific safety information system, as described in Chapters 3 and 4, capable of monitoring the safety performance of OCS operators and employers as a basis for documenting and promoting OCS safety.
- Using the elements of safety management identified by the committee (see Appendix A) in conjunction with statistical data on safety performance as a guide in motivating industrial managers, and in effectively implementing its own program.

SAFETY INFORMATION SYSTEM

Since the government's influence over OCS safety is through industry, the government needs information showing the effectiveness of procedures implemented as the result of the policies it sets. Needed are end product or performance data on the occurrence of accidents, incidents of noncompliance or unsafe events, and violations of operating rules.

To be useful, such data need to be recorded in a manner that reflects frequency of occurrence and severity of event. Furthermore, such data need to be in a form conducive to analysis. Monitoring safety performance -- the ability to document safety results and trends and to quantify the effects of policies and regulations -- is central to fulfilling the Minerals Management Service's role in achieving OCS safety.

A safety information system is integral to monitoring safety performance. A safety information system is a means of acquiring, collecting, storing, organizing, sorting, retrieving, and analyzing information on unplanned or unexpected incidents (including, where appropriate, near misses) relating to environmental damage or upset, bodily injury, illness, disease or death, and property damage or loss. The MMS already has, or has access to, components of a safety information system, but, the available system has the following weaknesses:

Missing elements Without extensive searching of records and manipulation, none of the available data can be aggregated by operator, employer or workplace to assist in identifying if and where safety problems exist and where less or more government attention is needed. For the purpose of monitoring safety performance, the performance of regulated industries, independent contractors as well as lessees and operators must be monitored and guided. At the present time, such targeting can only be accomplished through detailed study of individual records.

Monitoring safety performance requires that both event data (e.g., accidents and incidents of noncompliance) and exposure data (e.g., manhours worked, wells drilled, structures in place, and oil produced) be available, and that the data sets be statistically compatible. The event data acquired by the MMS and maintained in the Events File are limited to the Gulf of Mexico. Coverage of all OCS areas is needed. A major limitation on the usefulness of the Events File is the primitive state of development of the data base. Other than simple sorting operations by year or type of accident, for example, analysis can only be accomplished through special study. The committee understands that the Minerals Management Service is establishing a safety event data base at its headquarters to remedy these deficiences. The data base will use historical data from the Events File, but will be national in scope.*

The exposure data available to the MMS are not as complete as the event data. The biggest single gap is that no population data are available for OCS workplaces. A practical approach would be to require that employers periodically report man-hours worked by type of work activity for their employees working on the OCS. The reporting of lost-time injuries is already required, and a form for man-hours worked could possibly be modeled on the injury reporting form, to minimize the reporting burden. This would enable the monitoring of safety performance industry-wide as well as by OCS work activity, individual company, and OCS region. For industry concurrence with such a program, there would need to be only one personnel reporting system for the OCS.

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*This system was under development and not operational at the time of committee deliberations. The committee was not able to assess the adequacy of its design or performance.

Other exposure data needed in the OCS safety information system to calculate accident frequencies for monitoring safety performance include tallies of: drilling rigs on the OCS (already commercially available), fixed structures (obtainable from the platform inspection data base), production statistics (maintained by the MMS Royalty Management Division), and wells drilled (data kept in Borehole and Completion File).

Duplication There is some duplication of data reporting requirements and coverage of data bases. The duplication arises from the separate needs and requirements of the several federal agencies. The agencies have sought ways to eliminate burdensome duplicative reporting requirements but they persist. The OCS safety information needs of all government agencies can be met with a single system.

Suitability for Analysis The existing MMS safety reporting systems are heavily mixed with engineering and administrative data. The safety-related information is not always separated or identified so that it can be readily obtained and organized in a unified data base. The Minerals Management Service needs to organize the data available to it, augmenting the data as has been described, to establish a safety information system that supports monitoring and analysis of safety performance. The scope of the system should encompass event and exposure data. The data base should include all OCS data from MMS and other agencies as appropriate, and should be capable of basic statistical analysis.

Recommendation

The MMS should establish, in coordination with other applicable government agencies, a single OCS Safety Information System for monitoring the safety performance of OCS owners and employers. The system should:

- Acquire comprehensive OCS event and exposure data;
- Relate events to specific employers, locations, operations, and equipment;
- Calculate frequency and severity rates and analyze trends; and
- Permit monitoring of the relative safety performance of owners and employers, locations, and activities.

The MMS does not collect equipment reliability data, although it established and then cancelled a program to do so. The major operators on the OCS keep safety component failure data on some critical components. To conduct reliability studies, the government should access industry failure data as necessary.

The MMS only acquires specific information about the causes of OCS accidents or near misses when it conducts its own investigation. Such data are invaluable, but very costly when gathered through investigation. Through special study, the Coast Guard has collected limited incident-specific and also statistical data on workplace injuries and fatalities. These data are useful for safety analysis, but still lack exposure data.

MINERALS MANAGEMENT SERVICE SAFETY PROGRAM AND ORGANIZATION

The requirements implemented by the MMS take a systems approach to OCS safety (see Appendices A and B), but lack coordinated structure. Many MMS activities require the submission of data for engineering evaluation without recognition that safety improvement is an important purpose of such review. A safety focus for engineering requirements and activities suits the agency's missions, and is desirable from a system safety standpoint. With this focus, the importance and potential of program components would be more evident, as would gaps or excesses in requirements.

From a system safety viewpoint, the committee was able to identify both gaps and excess requirements in the MMS safety program (see Appendix B). Notable gaps include the lack of adequate procedures for acquiring, analyzing, and using safety data in a coordinated manner, especially to monitor safety performance (see pp. 27-28); failure to use positive incentives (see pp. 35-38) (except for the new SAFE Program); and inattention to human factors (see Appendix E). Requirements resulting in excessive data submission were found in the following areas: verification documentation (Appendix B, item 3.2), evidence of fitness of drilling unit (Appendix B, item 4.2), welding plan (Appendix B, item 5.3), quality assurance program (Appendix B, item 5.4), and erosion control reports (Appendix B, item 5.8).

The MMS employs a mix of professional skills appropriate to its program. Changes in program content or structure will necessitate commensurate changes in skills, including the addition of safety engineering expertise. Target areas in the future might include: management of the safety information system; integration of human factors concerns and positive incentive programs into the MMS safety program; and more extensive use of goal-setting, auditing for compliance, and performance monitoring.

2. THE GOVERNMENT'S ROLE ON THE OCS AND HOW IT AFFECTS THE ACQUISITION OF SAFETY INFORMATION

The government's role with respect to OCS activities is as the custodian and manager of OCS resources, to motivate industry to conduct operations safely, to disseminate information, and to foster the development and application of technology that will improve the safety of OCS operations. Legislation has assigned the government's role to several agencies. They are primarily the Minerals Management Service (MMS), U.S. Coast Guard (USCG), Environmental Protection Agency (EPA), Materials Transportation Bureau/Office of Pipeline Safety, and U.S. Army Corps of Engineers. The legislative authorities and roles of the agencies are discussed in Safety and Offshore Oil (National Research Council, 1981). The bulk of the responsibility is shared by MMS and USCG.

The MMS is charged with promulgating and enforcing regulations having to do with leasing and operations on the OCS, including the safety of life, property, and the environment. This includes carrying out national policy that states:

> "Operations in the Outer Continental Shelf should be conducted in a safe manner by well-trained personnel using technology, precautions, and techniques sufficient to prevent or minimize the likelihood of blowouts, loss of well control, fires, spillages, physical obstruction to other users of the waters or subsoil and seabed, or other occurrences which may cause damage to the environment or to property, or endanger life or health," (OCSLA 43 USC 1332).

The Coast Guard's responsibilities under the Outer Continental Shelf Lands Act (OCSLA) include safety regulations relating to unregulated, hazardous working conditions on the OCS (43 USC 1333 (c) and (e)). Its broad authority to regulate maritime safety also applies on floating OCS installations. The USCG shares responsibility for inspections, accident reporting, and investigations with the MMS.

The MMS has traditionally limited its direct authority to the operator/lessee. Although much work on the OCS is done by contractors, including the vast majority of drilling operations, MMS has no direct contact with these companies, either in directing them how to operate or obtaining safety or other kinds of information from them. By limiting its authority to the operator/lessee, MMS has a disadvantage in its efforts to motivate industry to conduct safe operations or to obtain basic safety data, such as man-hours worked. Although the OCSLA clearly places the ultimate responsibility for all offshore operations with the lessee/operator, the committee believes that MMS could request information directly from contractors under 43 USC 1348. In this regard, the committee acknowledges that contractors run the gamut from prime contractors, such as drilling contractors, whose supervisors are in direct control of OCS operations, to subsidiary contractors with limited discretion or effect on safety offshore. The MMS should target its efforts with contractors to areas where there are significant safety problems, and where contractors exercise significant control over the safety of operations or work performance.

Each agency has a particular mission, technical expertise, and operational capability. It is usually clear as to which agency is best suited to fulfill a particular responsibility, however, in some cases the division of responsibility is not clear. Where there is overlap between agencies, memoranda of understanding (MOUs) are established to resolve the difficulty. Gray areas still remain, and as a result there exists some duplication in areas of inspection and accident reporting. For example, since MMS and USCG each have some statutory responsibility for human safety on the OCS, both agencies require reporting of lost-time accidents. The MMS plans to drop its injury reporting requirements to reduce overlap with the USCG. Another example is that MMS and USCG inspect rigs separately, each checking for compliance with its own regulations. In contrast, a draft MOU between the EPA and the MMS provides for MMS inspectors to check for compliance with EPA permit conditions.*+

Duplication exists even though the OCSLA authorizes MMS to insure that "... inconsistent and duplicative requirements are not imposed." The joint jurisdiction of USCG and MMS causes confusion. The committee recognized that a single leader is essential to effective safety management (Rickover, 1980). Duplication is of concern because identical information is not requested by each agency since each uses its reports

*Michelle Hiller, EPA, personal communication, July 1983.

+Although memoranda of understanding are a common tool to reduce interagency overlap, agreement on their terms can take a long time. The Department of the Interior and the EPA have been trying for 10 years to reach agreement on an MOU for monitoring and enforcing EPA discharge permits.

for different purposes. This type of duplication leads to inaccuracies, misinterpretations, and lack of completeness as well as an administrative and cost burden to both government and industry. However, the committee also recognized that there is an absence of reliable information on safety performance on the OCS that can be compared with onshore operations.

To be effective in promoting safety one must not only acquire appropriate safety information, but also analyze, interpret, and disseminate it. The MMS devotes little effort to analysis and interpretation. The dissemination of information, which can be an integral part of an incentive or motivation program, is not effectively exploited by MMS or USCG. The safety alerts, for example, are useful to industry, and additional approaches to information dissemination must be sought.

Care must be taken in developing an approach to remedy this fragmentation as well as the duplication and overlap of responsibilities. It must be cost effective and clearly lead to increased safety. For example, the practice of separate inspections on a rig by MMS and USCG not only is burdensome and costly to industry and the government, but it also does not appear to enhance safety. In general, when there is an artificial division of responsibilities there may be a problem of the interface (possibly addressed by neither agency), which can have adverse safety implications.

In the conduct of inspections and to analyze and interpret safety data effectively (e.g., accident causes and effects, and number of lost-time injuries), there must be close cooperation and planning by MMS and USCG so that the information collected meets the needs of both agencies and can be analyzed and interpreted. It is preferable that a single agency acquires the data, a single agency analyzes the data, and that the data base be complete enough to satisfy the needs of both agencies. If there is a clearly defined and strong lead agency for the OCS, then the single reporting and inspection program will be more easily implemented than if the responsibilities of the OCS are shared. The concept of a single lead agency is paramount as is a single information acquisition system, along with analyses and dissemination of the information.

RESPECTIVE ROLES OF GOVERNMENT AND INDUSTRY

The OCS workplace has unique hazards and stresses (see Appendix E; Hunt, 1983; and NRC, 1981) which justify extraordinary attention to safety. Society places responsibility for providing a safe workplace squarely on the shoulders of the employer (84 Stat 1590). The closest control, i.e., motivation or enforcement, that can be exercised on the worker is that of the person's supervisor. Thus the training, motivation, and preparation of supervisors is fully as important as that of industrial workers. The ability to influence safety is increasingly hampered as responsibility moves from the immediate supervisor to a field, district, or division office, to a corporate office, or to a government agency. Contractors who provide labor or technical services on the OCS also complicate the chain of command.

As the ability to control actions in the workplace diminishes along the company chain of command, the control of company policy increases. Similarly, the Coast Guard and the MMS, which have no direct control over industrial workers, have extensive control over the industrial policies governing worker actions. Therefore, government efforts to advance safety have to be directed at industry management. They should cause industry top management to implement policy which allows middle and lower management to implement technical procedures necessary to accomplish desired goals.

Highly motivated operators can do a great deal to ensure the safety of their contractors; several companies require their contractors to have active safety programs. Operators monitor the results of their contractors' work and have the power to "run off" any contractor that does not adequately perform. Thus, under the current system, the operator is in much more direct contact and has more control over the contractors than any government agency.

Since the government's influence over OCS safety is through industry, the government needs information that shows the effectiveness of the procedures implemented as the result of the policies that are set. These are end product or performance data on the occurrence of accidents, incidents of noncompliance or unsafe events, and violation of policy. To be useful, such data need to be recorded in a manner that reflects frequency of occurrence and severity of event. Furthermore, such data need to be in a form conducive to analysis. Monitoring safety performance -- the ability to document safety results and trends, to quantify the effects of policies and regulations, and to audit performance -- is central to fulfilling MMS' role in achieving OCS safety.

3. OUTER CONTINENTAL SHELF SAFETY INFORMATION

A safety information system is integral to monitoring safety performance. In Appendix A, the committee defines a safety information system as a means of acquiring, collecting, storing, organizing, sorting, retrieving, analyzing and disseminating information on unplanned or unexpected incidents -- including, where appropriate, near misses -- relating to environmental damage or upset, bodily injury, illness, disease or death, and property damage or loss. The ability to analyze data is an important part of an information system. This capability is built into computerized data bases. Only the development of appropriate software is required to perform analysis.

The MMS already has, or has access to, components of a safety information system. This chapter identifies and describes the safety information system components, shows the extent of their usefulness in monitoring safety performance, assesses the adequacy of the safety information system, and defines the components of a safety information system that is sufficiently comprehensive to support the MMS role.

STATUS OF OCS SAFETY DATA

A variety of data bases are available to shed light on OCS safety. The most relevant are identified in Table 1, and described in detail in Appendix C. Each of the data bases is useful to some extent for monitoring OCS safety performance, but none of the data bases is completely adequate, nor can they be integrated with each other. The available data do support some bivariate statistical manipulations, and can be used to some extent to monitor safety performance.

Deaths

Both the Coast Guard and the MMS keep data on OCS fatalities (see Table 2). The disparity in the data is the result of different sources of information and activities covered.

TABLE 1 Summary of OCS Safety Data Sources

Type of Statistic	Data Base	Source of Data	OCS-Specific	Comments
Incident Data				
Workplace accidents (deaths/injuries)	International Association of Drilling Contractors (IADC) "Charlie" Report	Voluntary reports of participating companies	No	
	USCG Vessel Casualty Reporting System	Form 2692	No	
	USCG Personnel Casualty Reporting System			
	MMS Events File	Accident report	Yes	Gulf of Mexico only.
	BLS Annual Survey	OSHA Form 200S	No	
Production Accidents Data				
Loss of well control	MMS Events File	Accident report	Yes	Recent requirement -- no historical data.
Spills	USCG Vessel	Form 2692	No	Mobile offshore drilling units (MODUs) only.
	Casualty Reporting System			
	USCG Pollution Incident Reporting System	Form 4890	No	

TABLE 1 Summary of OCS Safety Data Sources (cont'd)

Type of Statistic	Data Base	Source of Data	OCS-Specific	Comments
	MMS Events File	Accident report	Yes	Gulf of Mexico only.
Fires/explosions	USCG Vessel Casualty Reporting System	Form 2692	No	MODUs only.
	MMS Events File	Accident report	Yes	Gulf of Mexico only.
Collisions	USCG Vessel Casualty Reporting System	Form 2692	No	MODUs only.
	MMS Events File	Accident report	Yes	Gulf of Mexico only.
Loss of structure	USCG Vessel Casualty Reporting System	Form 2692	No	MODUs only.
	MMS Events File	Accident report	Yes	Gulf of Mexico only.
Violations of operating orders	MMS Platform Inspection System	Field inspectors' reports	Yes	Current and historical data on operating deficiencies, by company and location.
<u>Exposure Data</u>				
Man-hours worked	IADC "Charlie" Report	Voluntary reports of participating companies	No	Drilling workers only.
	BLS Annual Survey	OSHA Form 200S	No	Participating establishments only (a statistical sample -- fewer than 10 percent of OCS workplaces participate).
Barrels produced	MMS Lease Production and Revenue File		Yes	Production records.

TABLE 1 Summary of OCS Safety Data Sources (cont'd)

Type of Statistic	Data Base	Source of Data	OCS-Specific	Comments
Platforms				
Fixed	MMS Platform Inspection System	Field inspectors' reports	Yes	Exposure data (platform years) can be derived from the complex/structure list. Gulf of Mexico only.
Floating	Offshore Rig Data Service	Commercial service	No	
Wells	MMS Borehole and Completion File	Forms DI9-3308 and 9-331	Yes	Can provide wells completed per year. Gulf of Mexico only.

TABLE 2 Fatalities on the Outer Continental Shelf

	USCG[a]	MMS[b]
1976	49	
1977	42	
1978	44	
1979	42	
1980	57	32
1981	33	11
1982		18

[a] Data drawn from USCG vessel and personnel casualty reporting system.
[b] Data drawn from MMS Events File.

MMS data include deaths as the result of workplace accidents. Coast Guard data include all deaths on the OCS, whether or not they are OCS workplace accidents. There are no comparable exposure data (i.e., man-hours) for use in calculating the frequency of deaths on the OCS. Thus, these data cannot be compared with other fatality data.

Injuries

The IADC calculates frequency rates for lost-time accidents of offshore drilling workers (see Table 3). These can be compared with data provided to the committee by two OCS operators (see Table 4).

Comparable, OCS-specific frequency-rate statistics cannot be developed from MMS or Coast Guard data because information on exposure, i.e., man-hours on the OCS, is lacking. The difference in accident frequency between Tables 3 and 4 represents the difference in safety performance between offshore drilling and production. The poorer performance can be attributed mainly to the greater risk present in drilling. Also, the definitions of lost-time accidents and exposure differ between the tables -- those used in Table 3 result in more conservative, higher statistics (see Appendix C). The improvement since 1977 shown in the tables represents the results of greater emphasis industry-wide on safety, largely on account of more comprehensive and stringent government regulation.

Table 5 compares the lost-time accident statistics of the OCS with those of other industrial sectors.

Loss of Well Control

Historical incident and frequency data have been developed through special study (Danenberger, 1980; Fleury, 1983) (see Table 6). Recently, the MMS has begun entering incidents of complete loss of well control into the events file. This, coupled with exposure data (e.g., wells drilled, wells completed, or producing wells) that are kept by the MMS will enable the MMS to calculate the frequency of lost well control incidents in the future.

Spills

The MMS and the USCG have separate requirements for reporting spills; spill data bases are compiled from the reports. Of the various data bases, that of the MMS is the only one specific to the OCS. OCS-specific data cannot be culled easily from Coast Guard data. Its systems, however, especially the Coast Guard's PIRS data base, provide as much or more information and analytical capability as those of MMS. Tables 7 and 8 provide a summary of oil spill incidents and frequencies from available MMS information.

TABLE 3 Lost-Time Accidents in Offshore Drilling

Year	Total Man-Hours Worked	Injuries	Accident Frequency Per Million Man-Hours	Per 200,000 Man-Hours
1973	15,313,919	797	52.04	10.41
1974	3,833,462[a]	782	49.06	9.99
1975	18,663,520	781	41.85	8.37
1976	18,184,585	1,076	59.17	11.83
1977	28,834,239	1,343	46.57	9.31
1978	36,173,267	1,797	49.68	9.94
1979	36,043,946	1,646	45.66	9.13
1980	37,077,474	1,518	40.94	8.19
1981	43,599,536	1,485	34.06	6.81
1982	46,558,981	1,231	26.44	5.29

[a] First quarter only.

SOURCE: "Charlie" Report of the International Association of Drilling Contractors (IADC).

TABLE 4 Frequency of Lost-Time Accidents during OCS Oil and Gas Production per 200,000 Man-Hours

Year	Company A	Company B
1973	1.2	0.7
1974	1.5	0.7
1975	1.7	2.1
1976	1.3	1.4
1977	1.7	1.7
1978	1.2	1.4
1979	1.3	0.6
1980	0.6	0.2
1981	0.5	0.8
1982	0.9	0.15

SOURCE: Company-confidential data.

TABLE 5 Comparison by Industry of Lost-Time Accident Frequencies in 1981

Industry (1981 Data)	Accident Frequency (Per 200,000 Man-Hours)
Agriculture[a]	5.9
Mining[a]	6.2
Heavy construction[a]	6.3
Manufacturing[a]	4.9
Lumber and wood products[a]	8.9
Oil and gas extraction (drilling)[a]	6.6
Oil and gas field services (production)[a]	9.2
Water transportation[a]	7.1
Offshore drilling[b]	6.8
Offshore production[c]	0.5

[a] Bureau of Labor Statistics Bulletin 2164.
[b] IADC "Charlie" Report (from Table 3). Note previously cited peculiarities of the data.
[c] Company-confidential data (from Table 4).

TABLE 6 Number and Frequency of Blowouts from 1968-1978

Phase of Operations	Number	Frequency
Drilling	36	1:264
Completion	4	1:1,484
Production	5	1:3,100
Workover	10	1:485

SOURCE: National Research Council, 1981.

TABLE 7 Number and Size of OCS Oil Spills[a]

Year	1 BBLS		1-6 BBLS		6-50 BBLS		50-1,000 BBLS		1,000 BBLS		TOTAL	
	Number	Barrels Spilled	Number	Barrels Spilled	Number	Barrels Spilled	Number	Barrels Spilled	Number	Barrels Spilled	Number	Barrels Spilled
1972-1982	94	91.6	999	2,909.2								
1971					35	475	10	1,235	0	0	45	1,710
1972					21	309	1	100	0	0	22	409
1973					26	377	0	0	2	14,935	28	15,312
1974					15	201	7	760	2	22,046	24	23,007
1975					13	161	1	166	0	0	14	327
1976					12	130	2	714	1	4,000	15	4,844
1977					16	248	4	670	0	0	20	918
1978					10	198	3	1,139	0	0	13	1,337
1979					16	181	2	115	0	0	18	296
1980					5	135	2	201	1	1,456	8	2,120
1981					3	40	3	202	1	5,100	7	5,342
1982					2	33	2	200	0	0	4	233

[a] Gulf of Mexico only.

SOURCE: MMS files supplied to committee.

TABLE 8 Frequency of OCS Oil Spills[a]

Year	Number[b]	Barrels Spilled[c]	Total Oil Production (million bbl)[d]
Less than 6 Barrels			
1971-1982	1:3.7	1:1.3	
Over 6 Barrels			
1971	1:9.3	1:0.2	387.4
1972	1:18.7	1:1.0	389.3
1973	1:14.1	1:0.03	375.8
1974	1:15.0	1:0.02	343.8
1975	1:23.6	1:1.01	314.9
1976	1:21.1	1:0.07	302.9
1977	1:15.2	1:0.33	291.7
1978	1:22.5	1:0.22	280.2
1979	1:15.8	1:0.96	274.6
1980	1:34.7	1:0.13	267.2
1981	1:40.9	1:0.05	270.2
1982	1:80.3	1:1.38	292.7

[a] Gulf of Mexico only.
[b] Number of spills per million barrels produced.
[c] Barrels spilled per million barrels produced.
[d] Data from MMS.

Fires/Explosions

In 1982, 30 fires and 2 explosions occurred on OCS fixed and floating oil and gas facilities. This number of incidents is consistent with historical data, as shown in Figure 1. During the period 1976-1979, for which numbers of facilities are available, the number of fires and explosions increased about 3 percent per year. During the same period, the number of working drilling rigs increased about 15 percent a year, and that of fixed structures about 4 percent a year. Thus, the rate of fires and explosions shows a level or slightly declining trend (National Research Council, 1981).

Collisions

Collisions of vessels with OCS structures are entered in the OCS Events File if the OCS structure is damaged. Two collisions are included in the Events File for 1982. Many more collisions are recorded in the Vessel Casualty Reporting System (CASMAIN) data base of the Coast Guard because Coast Guard entries originate with incidents reported by the vessel operator.

Loss of Structure

The Events File contains data on lost installations or major property damage. With cumulative platform years for different types of structures, which can be derived from the platform inspection data base, frequency rates for platform failures can be calculated (National Research Council, 1981). The CASMAIN data base of the Coast Guard contains comparable structural failure information for mobile offshore drilling units (MODUs) only. Tables 9 and 10 provide data on loss of drilling rigs and fixed structures.

Violations of Operating Orders

The platform inspection data base of the MMS reveals that in 1982, 5,500 citations or INCs (Incidents of Noncompliance with Operating Orders) were issued by MMS as the result of 7,000 site visits by field inspectors. Most INCs, such as those for pilots out of tolerance, were easily corrected. Platform inspection data provide current information on deficiencies, which can be used to identify not only the activities that pose the most consistent problems, but also the companies and locations. These data also provide MMS management with the means to monitor the activity of its field inspection offices.

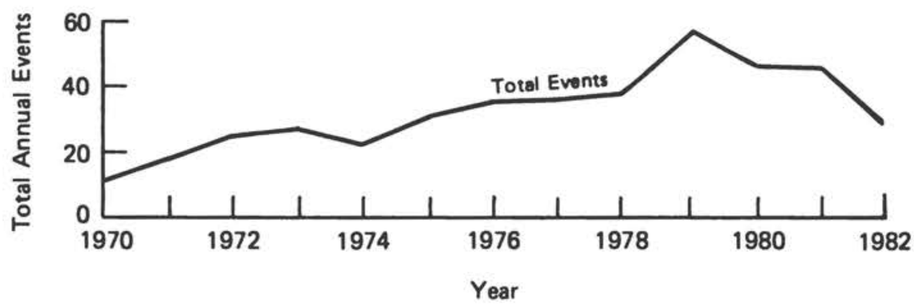

FIGURE 1 Fires and explosions in the Gulf of Mexico.

SOURCE: National Research Council, 1981.

TABLE 9 Frequency of MODU Loss (worldwide): 1973-1982

Period	Total Losses (A)	Total MODU-Years (B)	Loss Rate[a] $\frac{(A)}{(B)}$
1978-1982 (5 years)	18	2,537	.71%
1973-1977 (5 years)	21	1,581	1.33%
1973-1982 (10 years)	39	4,118	.95%

[a] Number of losses per cumulative MODU years, calculated as a percentage.

SOURCE: Adapted from McIntosh, 1983.

TABLE 10 Fixed Offshore Platform Exposure to Loss* in the Gulf of Mexico

Time Interval	Platforms in Place	Cumulative Platform Years (A)	Losses in Time Interval (B)	Loss Rate (A)/(B)
1947-1957	267	589	5	1:120
1958-1969	1,675	11,479	28	1:410
1970-1980	2,556	23,618	2	1:12,000

*A platform is considered lost if it was totally destroyed or so badly damaged that it had to be replaced. Single-well caissons are not considered to be platforms, and are excluded from this tabulation.

SOURCES: Platform loss data from the National Research Council, 1981, and the MMS Events File; platform exposure data from MMS.

ASSESSMENT OF USEFULNESS OF EXISTING SAFETY DATA

Missing Elements

None of the available data can be aggregated by employer or workplace to assist in identifying if and where safety problems exist and where less or more government attention is needed. For the purpose of monitoring safety performance, regulated managements should include independent contractors as well as lessees and operators. At the present time, such targeting can only be accomplished through time-consuming, detailed study, ad hoc, of individual records.

Monitoring safety performance requires that both event data and exposure data be available, and that the data sets be statistically compatible. The event data acquired by the MMS and maintained in the Events File are adequate for safety analysis, with two exceptions.

- The Events File was established and is maintained by the Gulf of Mexico Region. Since the Events File was established 14 years ago, OCS operations have been undertaken offshore Alaska and California, and in the Atlantic. The geographic coverage of the historical data is complete only for the Gulf of Mexico.

- The second limitation on the usefulness of the Events File is the primitive state of development of the data base. Other than simple sorting operations, by year or type of accident, for example, analysis can only be accomplished through special study. Even the analysis presented earlier in this section required manual manipulation of the data.

To remedy these deficiencies, the MMS is establishing a computerized accident information management system data base at its headquarters that will contain information on accidents since 1978 and be national in scope.* The data base is being established in dBase II, a flexible data management computer language. As initially established, the data base will contain event data only, although the system has the capability to include exposure data. The system will be able to sort events in a number of ways, by operator or time of year, for example, and also will be capable of analyzing trends and causes to the extent that this information is available in the original records entered into the data base. When exposure data are added, the system also will be capable of calculating accident frequencies. Additional comments on the potential of automation to improve OCS safety information management are contained in Appendix F.

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*The system was under development at the time of the committee deliberations. The committee was not able to assess the adequacy of its design or performance.

The exposure data available to the MMS are not as complete as the event data. The biggest single gap is that no data on man-hours worked are available for OCS workplaces. One approach to developing population data would be to require that employers periodically report man-hours worked by type of work activity, e.g., drilling, production, well servicing, and construction, for their employees working on the OCS, exclusive of staff support located onshore.* Since reports of fatalities and lost-time accidents are required by regulation, accident frequency rates could also be calculated to measure the acceptability of safety performance by total industry, OCS work activity, individual company, and OCS region. For industry concurrence with such a program, there would need to be only one personnel accident reporting system for the OCS. All interested government agencies should have access to the system. To minimize regulatory burden on small business entities, consideration could be given to exempting companies with 10 or fewer employees from submittal of the population data. The rate information might be required initially on a semi-annual basis for a trial period of 2 years and then extended thereafter on an annual basis, if justified.

The MMS also does not maintain an automated file of drilling rigs on the OCS although private companies provide this service to their oil company customers. A tally of fixed structures can be gleaned from the platform inspection data base, but the tally is not integrated in any way with other safety information. Similarly, production statistics, which are maintained by the Royalty Management Division of the MMS, are available and useful, but have not been integrated with other safety information.

Other exposure data bases that are potentially useful for safety analysis, but which are not currently integrated with or oriented to other safety information, include the Well Data File and the Borehole and Completion File. Both files keep tabs on OCS wells; the well file contains production information, and the other contains engineering data. All of these data bases are maintained in the Gulf of Mexico region and have regional, as opposed to national, coverage only, although similar information can be obtained from the other regions.

Duplication

Table 1 provides evidence of substantial duplication of data reporting requirements, and coverage of data bases. The duplication arises from the separate needs and requirements of the several federal agencies. The agencies have sought ways to eliminate burdensome duplicative reporting requirements, but they persist. OCS safety information needs of all government agencies can be met with a single system which provides prompt access to the user agencies.

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*An example of a form for these purposes is OSHA Form 200S which is used in a BLS national sampling program. This program provides a very small amount of data on a few OCS workplaces.

Suitability of Information for Analysis

To date, information has not been developed on the overall safety record of the offshore oil and gas exploration and production industry, or of the many individual companies who operate on the OCS.

Within the existing MMS safety reporting systems, engineering data are heavily mixed with administrative data. The safety-related information is not always separated or identified so that it can be readily accessed in a unified data base.

The MMS needs to organize the data available to it, augmenting them as has been described, to establish a safety information system that supports monitoring and analysis of safety performance. The scope of the system should encompass event and exposure data. The data base should include all OCS data, and should be capable of the basic manipulations of statistical analysis. The best safety data system would result from a completely new design of the data base. Such an approach was taken by MMS in its recent development of the revised royalty management data reporting system, and should be given consideration in this case.

Individual company data systems vary and cannot be readily consolidated for comparative purposes. They have the information needed for a common system, but the information has to be collected and consolidated to be usable. A few of the major producing companies also accumulate information about the frequency of contractors' accidents while the contractors are working for them. Others require contractors to provide them with information about accidents before and during employment. Individual company systems are tailored for the company and their insurer. One major producing company for, instance, uses the 24-hour exposure criteria described elsewhere for the maritime transportation industry.

The MMS does not collect data on the reliability of safety devices, although it established and then cancelled a program to do so (as described in Appendix B, item 5.7). The major operators on the OCS keep failure data on some of the critical components. To conduct reliability studies, the government may be able to access industry failure data.

Unless it conducts an investigation, the MMS does not acquire causal data on OCS accidents or near misses. Such data are invaluable, but very costly to develop since they can only be gathered through investigation. The Coast Guard has, through special study, developed limited causal data on workplace injuries and fatalities. These data have been and will continue to be useful for safety analysis, but they suffer from the same limitations as the event data; that is, without exposure data, the causal data cannot be related to accident frequency.

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The reports of field inspectors provide a wealth of information on operating deficiencies by company and location, which can be used for both internal and external safety management purposes. MMS management can use these data to target the activities that pose the most consistent problems, and also the companies and locations. The data also provide a means of tracking the activities of field inspection offices and field inspectors. However, for this information to be used consistently and frequently for safety management purposes, the data need to be in a readily available, readily analyzable form. This is not currently the case.

4. SYSTEM-LEVEL ASSESSMENT OF THE MMS SAFETY MANAGEMENT PROGRAM

This section describes approaches to a safety program, and analyzes the links between safety information and management. It draws on and, in some cases, summarizes information presented in the Appendices.

ALTERNATE MODES OF SAFETY PROGRAM IMPLEMENTATION

The MMS's major safety mission is to encourage industry to operate safely. To influence industry to act safely, the government must have things it wants industry to do (i.e., set goals and standards), it must be able to encourage industry to do those things (i.e., enforce and motivate), and it must have a way to know if industry is doing them (i.e., determine compliance). The MMS can apply its goals and standards in a number of ways. It can require specific technologies and procedures or set general performance standards or safety goals. The means of detecting and motivating compliance with safety objectives differs with the approach, and the government requires different information to set goals, enforce or motivate, and determine compliance. Table 11 summarizes the approaches to regulation and their different information characteristics and requirements.

The most specific type of regulation is that which requires specific technologies or practices. For example, Gulf Coast OCS Order 1 describes precisely how OCS structures must be identified (30 CFR 250). Another example is the Coast Guard regulations that prescribe specifications for life jackets and survival suits (46 CFR Sub. I-A, parts 107-109; 33 CFR Sub. N. parts 140-147). Specific standards are straightforward -- the company simply has to follow the directions --and it is similarly easy for the government to check for compliance because an inspector can go by the book. On the other hand, the mere employment of a technology does not ensure that it will be maintained and used correctly.

Detailed knowledge of technologies or practices is required to set specific standards. That is why such standards are often developed by industry and then incorporated into regulation by reference.

TABLE 11 Approaches to Regulation

Type of Regulation	Technique of Determining Compliance or Effectiveness	Motivation or Enforcement	Information Needed	Comments
Specific regulations requiring particular technologies, practices, or training	Inspection: compare to requirements Documentation for training programs and for procedures	Civil penalties, shut-ins	To set standards: specific knowledge of technology or practices To inspect: knowledge of rules, standards, checklists	May inhibit technology. High certainty of outcome. Connection to safety performance may be weak. Takes responsibility away from industry.
Equipment performance regulations, or procedure performance requirements	Documentation, inspection, or audit	Civil penalties, shut-ins	To set standard: knowledge of safety requirements and technological capabilities	Allows more flexibility. May be more difficult to comply with and more difficult to determine compliance. To inspect, need ability to test or other way to ascertain performance
System level requirements, e.g., general training requirements	Documentation	Civil penalties, shut-ins, denial of permits	Minimal information requirements	Responsibility on operator (internal control).
Performance goals and standards in terms of number of injuries or incidents of pollution	Safety records, pollution records, monitoring	Publicity, rewards, lease sanctions, civil penalties, positive incentives	Public values, and risk/benefit trade-offs to set standards; accident data, exposure data to check compliance	Not sufficient for high consequence risks. Very flexible. Direct correlation to ultimate goal.
Positive incentives	Monitoring of safety performance	Award programs, publicity, public recognition of achievement (or lack of achievement)	Safety performance data	Quality of program management is important.

The establishment of specific standards may tend to freeze technology -- thus attention to updating is important. Using industry consensus standards that are updated frequently, such as American Petroleum Institute (API) recommended practices, circumvents some of the problems of out-of-date standards, and also reduces the information required of government.

At a more general level, standards can specify technologies or practices the operator should use, but allow flexibility in choosing the specifics. There is no clear dividing line between performance standards and regulations which specify technologies and practices, but rather a spectrum. For example, a requirement that blowout preventers be in place and be testable at a certain pressure allows more flexibility than a standard that describes the exact type and configuration of blowout preventers, but it is less flexible than a performance standard that requires well control maintenance with no specifications about how well control should be achieved. Many OCS orders are of this intermediate type, requiring equipment that meets certain performance characteristics without specifying the design. For example, Gulf of Mexico Order #2, Section 6.2, specifies requirements for mud pit level indicators, mud volume measuring devices, and gas detecting equipment, but it says nothing about the required design.

Determining compliance with equipment-performance standards is often more difficult than determining compliance with more specific standards. It is easier for an inspector to tell if fire hose brand X is on the rig than to tell if the rig's fire hose can pump X gallons per minute. Compliance with some performance standards can be checked by testing the equipment. For other standards, it might be very difficult for an inspector on a rig to determine if a piece of equipment does what it is supposed to do. Similarly, it is easier to see if a company follows a specific procedure than it is to determine if the procedure a company follows is adequate. To set equipment performance standards requires less detailed knowledge but more general information than specific standards; the government needs to know both what performance levels are needed for safety and the performance level that state-of-the-art equipment is capable of achieving. The advantage of an equipment performance standard is that it permits much more flexibility in technology and practice -- a company is free to use a newer technology that performs the same function more efficiently.

At a next more general level, a system safety level, the regulations describe in general terms the required technologies and programs. Examples of this might be requirements for training workers, that a platform be able to withstand a wave of particular force, or that it have a firefighting system capable of extinguishing certain types of fires. These regulations put the responsibility on the company to demonstrate that it has these capabilities, but leave the means of compliance up to the company. This type of approach is used in Norway, where the operators are unambiguously responsible for the safety of their operations.* In the United States, requirements for exploration plans, comprehensive permit applications, and platform verification are at this level. In documents such as the Application for Permit to Drill (APD) of the MMS, the operator must specify in detail the technologies and procedures to be used. These are checked for adequacy by the MMS district office to determine if they are sufficient. In the Platform Verification Program, independent certifying organizations review the design and construction of platforms to certify their safety.

At this level, compliance is determined by reporting requirements and government checking. The government needs to have enough expertise to determine if the operator's plans are adequate. The advantage of system level programs is that they allow a great deal of flexibility and opportunities for innovation. Innovations can be made if the operator can demonstrate that they are adequate.

The most general level of regulation is a statement of goals or standards, which specify the permissible amounts of pollution or frequency of injuries. No comprehensive set of safety goals has been established for the OCS (although U.S. operators are unambiguously responsible for the safety of their operations). Norway presents some contrast in this respect; there, a numerical goal for the reliability of offshore structures has been established. The Norwegian system can be cumbersome to implement because it calls for extensive documentation on the part of the operator and documentation review on the part of the regulator. Furthermore, the effectiveness of the Norwegian goal for reliability has not been evaluated. Also, the workability of a meaningful demonstration that the numerical goal has been achieved has not been addressed.

Performance standards are common in EPA's air and water pollution regulations, such as automobile emissions standards, which specify allowable discharges into the air and water without saying how they are to be obtained. Performance standards are less appropriate for regulating events for which no level of incidence is acceptable, such as deaths or major pollution events.

Regardless of the technique(s) of regulation employed, the MMS has a legal obligation to require safe operations, including requiring a floor or basic level of safety performance. The great majority of operating companies will achieve the desired level of safety performance as the result of corporate objectives and programs and in response to government regulations. However, the MMS needs to take into account that at any point in time there may be some operators in some locations who do not respond to motivation and do not act responsibly. By requiring every operator to perform at some basic level of safety performance (under the threat of suspension of operations), the MMS is protecting itself, the offshore oil and gas industry, and the nation, from slothful operators.

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*Dr. Chris Hill, Massachusetts Institute of Technology, personal communication, March, 1983.

FACTORS TO CONSIDER WHEN SETTING GOALS

The setting of safety goals is highly desirable. Goals can motivate if they are set at a level that challenges the skills of individuals and organizations, and are not too easy to achieve nor so difficult as to be unachievable. However, when developing safety goals it becomes clear that there are so many associated problems that it is an extremely difficult task. One of the main difficulties is that goals must be verifiable, to know if they are attained. Goals might need to be different for each facility. They might depend upon the activity (exploration versus production); geographical region; environment (e.g., sensitive ecosystem or harsh weather); production capacity; and the facility's age. A set of goals would be needed rather than a single safety goal for a given facility, and they may be both qualitative and quantitative in nature. Some goals may be absolute, others may be relative.

If attainment of a goal is subject to factors beyond an operator's control, then a process or means goal rather than an end goal may be desirable. Goals need to be flexible so that they can be changed with time, or if conditions change. Goals ought to be carefully set and then evaluated on a test basis for a few facilities before they are implemented industry-wide.

When one sets a performance standard, one is in effect setting a goal. However, standards may be too general, goals too vague, and feedback too infrequent to assure adherence to standards and attainment of goals. While performance standards may be a very important part of the MMS safety and information system, care is needed to ensure that suitable standards are selected and adequate feedback is provided. The objective is not to provide the owner/employer with ideal or unrealistic performance standards, but rather with goals and feedback which will improve safety behavior in the workplace.

OPPORTUNITIES AFFORDED BY MONITORING SAFETY PERFORMANCE

The lack of an information system for monitoring the safety performance of OCS owners/employers affects many aspects of OCS safety regulation as previously explained. This section describes the opportunities afforded by monitoring safety performance.

Once incident and rate data are available, indices of safety performance can be constructed concerning fatalities, injuries, spills, other operational incidents, and structural failures. The indices can be constructed for owners and employers. They can be aggregated by region, type of operation, type of event, or type of company, and depending on the flexibility of the data base, by other factors. The data can be kept confidential or can be made anonymous for public circulation. Publicizing safety performance can motivate companies to direct their attention to safety. For example, occurrence of accidental spills has dropped concurrently with acceptance of the requirement to report spills to government authorities (see Table 8); this suggests that simply requiring events to be entered in the public record may motivate companies to work on the problems.

Behavior also can be affected by both positive and negative incentives. The current system of regulation, inspection, and enforcement consists primarily of negative incentives to motivate safe practices. Positive incentives are needed; they might include awards or reduced enforcement burden. Accurate, up-to-date safety performance information is a necessary element of a positive incentives program.

The following are examples of applications of performance data for the purpose of enhancing and encouraging safe practices.

Non-Public Applications

- From time to time, lessees, operators, and contractors could be provided with a safety performance status report. The report would cite the best, worst, and mean safety records for the activities in which the company is engaged, and the company's safety record. Other comments could be included as appropriate.

- The frequency and thoroughness of inspections could be based to a large extent on safety performance. Such a policy would remind the poorer performer of safety, and because inspections take time and thus are costly to the operator, it would reward the good performers by taking less of their time. This is an example of a relaxation of a negative incentive. It would also make better use of government resources by concentrating them on problems.

- The MMS could consider safety performance in awarding and setting terms of leases and conditions of conducting operations. This would require a statutory change.

Public Applications

- Positive incentives such as awards and recognition are particularly helpful in spurring individuals to act safely. This is important since so many accidents are attributed to human error. Similarly, awards in recognition of safe performance are helpful in motivating companies to act safely.

- A vehicle for making comprehensive safety performance information widely available could be the addition of an environment and safety chapter to the "Summary Report" series of the OCS Oil and Gas Information Program of the Minerals Management Service. Summary reports are prepared periodically on the OCS activity in each region, and are distributed widely to interested persons in the industry and to state and local government officials.

- Public media could, from time to time, be provided with up-to-date information on safety performance. These might include lists of the 10 best or worst operators or contractors along with statistical synopses of safety performance.

- A public annual award, a positive incentive, to the best safety motivation program by large and small contractors could require those who compete to disclose their methods as well as demonstrate that they work well. Hence information not in the public domain prior to the award process would become accessible to both federal agencies and companies.

The kinds of activities outlined above would make it possible for workers to compare the safety records of companies. Some might choose to work for safer companies. This might make it more costly for poor performers to hire workers, and would provide an incentive for a greater emphasis on safety. Similarly, companies hiring contractors might favor safer companies. Publicizing safety records might also promote competition in safety among workers and between companies. Many companies use internal competition between divisions or between rigs to promote safety, and it seems to be a powerful motivating technique. Finally, some public pressure in favor of safer companies is likely to result from publicizing safety records.

Even the best positive incentive safety program may have little impact if the link between incentive use and improved safety performance is not perceived. Delays in making awards, poorly defined criteria, inappropriate incentives, and many other related factors can mask these linkages.

Incentives are clearly a basic part of any safety information and utilization system, but their use is complex. Expert professional staff is required to select and evaluate incentive systems. Positive incentives are cost-effective in that they lead to a more modest federal enforcement role, and they make information available to a broader spectrum of users.

The offshore industry already uses positive incentive programs, and the API has published descriptions of a variety of approaches which might be used, as well as descriptions of some specific safety award methods (American Petroleum Institute, 1974).

The MMS has developed an OCS Safety Award for Excellence (SAFE) program to recognize exemplary performance on the OCS by a lessee, an operator, a contractor, or individuals. The process of announcing the program, receiving applications, evaluating applications, and making and publicizing awards is expected to motivate safety performance in a number of ways. It is expected to:

- Elevate the awareness of safety and pollution prevention by recognizing exemplary performance;
- Encourage voluntary compliance with regulatory requirements to increase environmental protection, safety of operations, and conservation of resources;
- Provide the public with a better understanding of the professional manner in which oil and gas operations are conducted on the OCS;
- Encourage excellence in safety and pollution prevention through the development and implementation of new technologies and practices; and
- Recognize that safe operating practices enhance the protection of offshore personnel.

The OCS districts of the Minerals Management Service make SAFE awards twice a year. A national award is made once a year. The first SAFE awards were presented in 1983.

In addition to structuring its development of positive incentive activities along the lines suggested, the MMS should consider periodically evaluating the safety and motivation activities of owners and employers. To evaluate companies effectively, the MMS would either establish an in-house capability in human and organizational safety motivation, employ another government agency that has this capability, or contract for such services.

Before it can fully reap the benefits of monitoring safety performance, the MMS needs to complete the supporting data base, described in the previous chapter, including the development and distribution of safety performance information. Furthermore, its procedures need to reflect the technical wisdom of safety professionals and others who make use of the safety data.

THE IMPORTANCE OF ANALYZING, INTERPRETING, AND DISSEMINATING SAFETY INFORMATION

The MMS collects much safety-related information. Some information, such as notice of accidents, is provided in response to reporting requirements. Other operational information germane to safety is provided in the form of plans for review and approval. Still other safety-related information may be developed directly by the MMS.

Information should be acquired in response to the needs of decisionmakers. To be useful, information systems should consist of information acquisition, analysis, and utilization elements. While the MMS has in place some necessary OCS safety information elements, these elements have not been integrated into an analysis and utilization component to support improved safety regulation and industrial safety. Even so, the MMS has devoted some effort to greater analysis and use of safety information. Examples include analyses of oil well blowouts (Danenberger, 1981; Fleury, 1983), and analytical reviews of OCS Safety Alerts (Oil and Gas Journal, May 2, 16, 30, 1983).

Developing an organization within the MMS for the purpose of safety information analysis and utilization would provide an organizational home for the safety information activities of the MMS. It would provide a locus for the MMS safety mission that would be beneficial in focusing technology development, regulatory enforcement, and motivational programs on safety objectives.

ASSESSMENT

The MMS' OCS safety regulatory program contains some of each of the kinds of regulations discussed in Table 11. This mix of approaches is appropriate, given the range of objectives of OCS regulations and the wide-ranging subject matter. The review of MMS safety programs contained in Appendix B and above reveals certain areas for attention.

The Minerals Management Service's requirements contain many components inherent in a systems approach to OCS safety (see Appendices B and C), but the components have neither been organized nor drawn together. Many of the current activities of MMS require the submission of data for engineering evaluation by the government without recognition that the overriding purpose of this review is safety. A safety focus for MMS engineering requirements and activities is appropriate to the implementation of the agency's missions, and is desirable from a system safety standpoint. With a safety focus, the importance and potential of the program components would be more evident, as would gaps or excesses in requirements.

From a system safety viewpoint, the committee was able to identify both gaps and excess requirements in the MMS safety program (see Appendix B). Notable gaps include the lack of ability to acquire, analyze, and use safety data in a coordinated manner, especially to monitor safety performance (see pp. 27-28); failure to use positive incentives (see pp. 35-38) (except for the new SAFE program); and, inattention to human factors (see Appendix E). Requirements resulting in excessive or duplicative data submission were found in the following areas: verification documentation (Appendix B, item 3.2), evidence of fitness of drilling unit (Appendix B, item 4.2), welding plan (Appendix B, item 5.3), quality assurance program (Appendix B, item 5.4), and erosion control reports (Appendix B, item 5.8).

Another issue is the development of a staff of safety experts within the MMS who can participate in the administration of the safety program. Many MMS requirements are implemented through reports or applications prepared by industry which are then approved or disapproved by government. The effectiveness of this approach depends to a great extent on the technical qualifications of the government personnel who review the materials that are submitted, or who inspect. The MMS has a mix of professional skills that is appropriate to the implementation of the existing program. Changes in program content or structure would necessitate some changes in the skills of the MMS. Two examples:

- Were the MMS to establish a central office to oversee its safety program, including managing an OCS safety data base and targeting regulatory efforts accordingly, it would be appropriate to develop or acquire appropriate system safety expertise for program management.

- For the MMS to pay greater attention to human factors, it will need the assistance of experts in workplace safety and human behavior.

Other models for regulatory implementation, if used by the MMS, would call for other skills on the part of MMS personnel. Some regulatory agencies, notably the Nuclear Regulatory Commission, have adopted an audit approach to regulation.* In an audit approach, companies are required to have certain plans and programs and to keep records of compliance with goals, standards, and regulations, but they are not required to turn over records or otherwise report to the government. Instead, from time to time, the government audits the company's records to determine compliance and achievement of goals. Auditing reduces paperwork and eliminates duplication between company and government requirements. Although the opportunity for cheating will

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*The reader should be aware that the Nuclear Regulatory Commission's (NRC) use of audit is related to a different problem than faced by MMS. The NRC must contend with and manage a voluminous, complex, and diverse data base that includes product or work inspection certifications, worker qualification certifications, instrument calibration certifications, and material certifications for each of the many manufacturing and construction steps for an enormously large and complex installation.

always exist, it can be reduced with civil or criminal penalties. If audits have a potential disadvantage it is that they require expertise and diligence on the part of government personnel and good intentions on the part of industry to ensure safety. If a company were to cut corners and was not audited, a decreased level of safety could result.

More extensive use of goal-setting, auditing for compliance, and performance monitoring would focus greater attention on safety while reducing regulatory burdens. Yet, reorienting the OCS safety program in this manner would require new skills on the part of MMS personnel. Regulatory engineers and field inspectors would have to develop knowledge of management, system safety, and safety engineering. Petroleum engineers would need to be augmented by human factors and system safety experts. Those who review and inspect would need to learn the related but different tasks involved in conducting audits. Planning for such innovations would be facilitated by phasing in trial programs and analyzing the results.

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APPENDIX A*

ELEMENTS OF SAFETY MANAGEMENT SYSTEMS

NATURE OF SAFETY

A major detriment to safety is the public's lack of understanding of the nature of safety or how safety is achieved. Generally, public attention is drawn to safety by accidents. Numerous books and papers have shed considerable light on the nature of safety. Many have had different approaches, but overall there has been a remarkable similarity in some of the basic ideas which have been propounded.

One dictionary defines safety as freedom from danger, injury, or damage (Guralnik, 1978). Since the concepts of safety are sometimes difficult to understand or assimilate, it is useful to look at the opposite of safety, i.e., a condition where accidents causing danger, injury, or damage occur. Accidents are defined as unplanned or unexpected happenings (Guralnik, 1978). Many safety professionals believe that near miss incidents are as important statistically as actual incidents.

Many managers pride themselves on conducting their operations in such a competent manner as to minimize unplanned or unexpected happenings. This objective is the result of sound management practices, such as organization, planning, adequate training, competent supervision, and planned maintenance. If these management practices can be used to minimize unplanned and unexpected happenings, they can also be used to achieve safety. Thus, safety is closely related to good management.

It also follows that safety is not an independent discipline, nor is it a commodity or thing which can be simply acquired. It might be likened to an attitude or an operating philosophy which develops within an organization, and within an individual. Safety can be nurtured, improved, and refined through training and repetition. It cannot be achieved just by hiring a safety inspector or a safety engineer to perform safety-related duties, or, for that matter, just by developing a safety information system.

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*This background paper was compiled by the committee based on the findings of its study.

DEFINITIONS

The committee considered it necessary to define some of its terminology. This need for definition has been previously recognized in studies of safety (Miller, 1979).

- Safety information comprises reports, investigations, analyses, and statistics concerning unplanned or unexpected incidents relating to environmental damage or upset; bodily injury, illness, disease, or death; or property damage or loss occurring on or adjacent to the outer continental shelf (OCS) as a result of oil and gas operations.

  Most information relating to or concerned with management could be referred to as safety information. There seems, however, little point in confusing the concept of safety by tagging various forms of conventional management information as safety information. It seems more reasonable to limit the concept of safety information to matters pertaining to safety or the lack of safety. Safety in itself generates little information and few statistics, but, the opposite condition, a lack of safety, does generate information and statistics. If one studies or investigates accidents or other unplanned events it is often possible to determine their number, severity and frequency, and possibly their causes. Such information can be applied to eliminating or minimizing unplanned events.

- Information system pertains to a means of acquiring, collecting, storing, organizing, sorting, retrieving, analyzing, and disseminating one or more types of information, including, but not limited to, statistics, reports, and technical papers which are in some convenient form such as printed pages, tables, graphic displays, computer media, or video/audio recordings.

- Safety information system pertains to a means of acquiring, collecting, storing, organizing, sorting, retrieving, analyzing, and disseminating information on unplanned or unexpected incidents relating to environmental damage or upset; bodily injury, illness, disease, or death; and property damage or loss.

- Management information systems are information systems designed to handle one or more types of information for the use and/or guidance of management.

  Management information systems are designed to furnish necessary information to management to enable managers to make organized, sound, and logical decisions. In the context of this study, a management information system might comprise various information systems, including safety information systems, and a variety of technical data from geosciences to economics.

- Information system management is the technique or system used to operate a specific information system. This term could be applied to the technique or system used in operating and managing a specific information system. It could conceivably be applied to a person or a relatively limited group of people assigned the task of managing an information system.

- Management system pertains to a pre-planned and organized method of evaluation, analysis, and decision making created for the purpose of assisting decisionmakers in the skillful direction of a specific activity, operation, or other area of interest.

- Safety management system is an organized plan to acquire, collect, store, analyze, organize, disseminate, and evaluate all types of safety information relating to operations and with provisions to use such evaluations to improve safety through the reduction of unplanned and unexpected events.

PRECEDENTS FOR REGULATORY SAFETY MANAGEMENT SYSTEMS

Most regulatory safety management systems have been developed over time in response to a need indentified by Congress, usually as a result of some particularly severe accident involving lives, property, or the environment. One of the early examples of such a system was the Steamboat Inspection Service, which was established to cope with accidents to steamboat boilers. This agency was later merged with the U.S. Coast Guard which is still involved with regulatory matters covering ship safety. The present regulatory safety system, however, is far more comprehensive and broader based than the initial safety systems established by the Steamboat Inspection Service.

There are other regulatory safety management systems in government which have adopted and explored a variety of strategies for achieving safety. All of these provide some assistance in determining which strategies may be most useful and successful to the Minerals Management Service (MMS). However, there is no readily available, highly efficient, well-tested regulatory safety management system in place that can be used as a comprehensive model for the development of the ultimate OCS safety management system for the MMS.

It is essential and helpful to recognize that most regulatory safety management systems have been dictated and established in accordance with statutes, which have in turn normally been generated by some specific and limited incident or situation. For this reason, the systems have seldom been created with the initial purpose of addressing safety from a broad perspective.

At the same time these regulatory activities have been developing, there have been numerous students and investigators interested in safety, and how to achieve it. They have produced a large body of literature and have shed considerable light on the subject of safety and safety management. Th^ professional groups most active in engineering safety include: the American Society of Safety Engineers, the System Safety Society, the National Safety Management Society, and the Human Factors Society. These organizations and their members wrestle with the problem of establishing safety or a safe working environment in a plant, corporation, or other organization. The demands of government oversight of safety have not received as much attention. Nevertheless, much of the available information is useful and applicable to the regulatory process.

The oldest group, the American Society of Safety Engineers, founded in 1911 is concerned with: the ratio existing between major accidents, minor accidents, and incidents or near misses; the need for top management interest in safety; the need to train people; and the need for engineering safeguards. The National Safety Management Society, chartered in 1966, espouses that: safety is not just engineering, it is a function of and must be integrated into management practices; safety efforts should improve productivity as well as create a condition free of accidents; and safety results from good management and is inherent in proper management.

Principles of system safety, promoted by the Systems Safety Society, chartered in 1954, include the need: to consider the total system including man, the machine, and the environment or surroundings in achieving safety; to identify and analyze incidents or near misses as well as actual accidents; to identify and systematically eliminate hazards; and to keep in mind the individual and the surroundings while engineering the equipment.

The Human Factors Society, incorporated in its present form in 1964, concentrates on the necessity of dealing with the human part of the safety equation. This applies to the level of performance of managerial personnel as well as the workman on site.

ELEMENTS OF SAFETY MANAGEMENT

The various philosophies of safety that have been summarized above make it evident that numerous elements are important in safety management. Following is a compilation and description of the elements of safety management. Table A-1 provides a summary of the elements of potential interest in a safety management system.

Guidance

All systems need guidance, whether provided by humans or by some mechanical means such as a computer. In most safety systems, the issues and problems are complex enough to require human guidance. Guidance encompasses goal and priority setting, the scoping of safety efforts, and the developing of strategies for achieving safety goals.

TABLE A-1 Elements of a Safety Management System

Guidance

- o Setting priorities
- o Establishing goals
    - long term
    - short term
- o Defining scope of system
- o Developing strategy

Attitude Development

Hazard Identification and Analysis

Safety Planning

- o Engineering (related primarily to hardware)
    - reliability
    - human factors (ergonomics)
    - quality assurance
- o Operational
- o Training

Development of Safety-Related Requirements

- o Engineering (related primarily to hardware)
- o Operational
- o Training

Accident/Incident Investigation

Information System, Including Information Analysis

Resolution of Perceived Hazards

Safety Communications

Emergency Procedures

- o Plans
- o Organizations and equipment
- o Medical services

Enforcement

- o Inspection
- o Safety audit
- o Penalties

Safety Hotline/Advocate

Attitude Development

The development of a high degree of interest, belief in, and awareness of safety among all of the persons involved is universally recognized as an important element in most successful safety programs. It is because of this that most safety professionals believe that safety must start at the highest levels of management and work its way downward. The means of achieving such attitudes throughout an organization vary with the size and type of the organization. In one case the attitude may be the product of one man's efforts; in another instance, sophisticated communications programs may be developed to engender safety consciousness.

Hazard Identification and Analysis

Hazard identification and analysis is a function inherent in most safety programs within any form of organization trying to develop a safe condition. It can involve everything from failure mode and effect analysis to fault tree analysis to field inspections to analytical studies. Whatever the means, the objective is to identify problem areas so that they can be eliminated before an unplanned or unexpected incident occurs. Best's Loss Control Manual and Best's Underwriting Guide are examples of compilations, through past experience, of various potential hazards which may exist in a wide variety of commercial activities. Such information can be used in identifying and analyzing hazards in an organization and system to minimize unplanned events.

Safety Planning

Safety planning covers such activities as staff efforts to consider and initiate precautionary safety-related efforts in the areas of engineering, human factors (ergonomics), and quality assurance. Safety planning may include efforts to influence hardware reliability. The planning element also encompasses the development of operational procedures, and requirements for operational and technical training.

Development of Safety-Related Requirements

This element is related to the development and promulgation of minimal standards and rules within the scope of the system. As with safety planning, this element addresses engineering, operational procedures, and training. In the area of engineering, it addresses the development of minimal standards for hardware and for the computer-related software used in controlling the hardware. This could be the appropriate element to address the BAST (Best and Safest Technology) concept required by statute.

Under the area of operational procedures, the requirements development might address such matters as intervals for checks, testing, emergency drills, length of work periods, and other matters where human functions and tasks are involved. In the matter of training, this development would be concerned with minimal levels and topics of training. Such minimal training concepts already have been applied in various ways by regulatory bodies. A further extension of this part of the element might involve personal certification and/or licensing to insure minimal training.

Accident/Incident Investigation

This element concerns the investigation and analysis of accidents and near misses (i.e., incidents) so that measures can be taken to insure that similar incidents do not recur.

Information System

This element is, in a sense, a specialized library to serve the management system under consideration. An information system might be designed to acquire, organize, store, and retrieve information. It also could be designed to analyze and distribute the data in the system.

The system could be designed to handle and store technical papers, technical specifications, reports of accidents or incidents, plans, written or graphic compilations of deficiencies, and administrative data, such as status of reports, inspections, and operations.

A safety information system could be developed in two general ways. It could be customized very specifically to meet the needs of a particular situation or task, or, it could be designed more generally to cover both present and foreseeable needs. The first approach has the obvious advantage of economy while the second is more flexible and adaptable to changing conditions.

Resolution of Perceived Hazards

This element involves the function of monitoring or tracking what happens after a specific hazard is identified, either through some form of analysis and direct observation, or through investigation of an actual accident or incident. Normally such perception would be followed by some form of recommendation or safety requirement. This element insures that the effects of the changes are noted, and that potential negative effects of hazards are eliminated or neutralized. In any given organization or system, this function could be combined with the unit doing safety information analysis or safety planning, or with the guidance element.

Safety Communications

The importance of good communications between people and organizations involved within the scope of the system is self-evident. Numerous forms of communication may be involved including various reporting forms, correspondence, and formal directives or releases. Much of the communication will occur as the result of project administration, but safety communications must be formally considered so that communications do not end up being one way. It serves no purpose to gather and process information if the conclusions and lessons learned become buried in the system. Effective communications throughout the system is essential.

Enforcement - Safety Audit

Checking and auditing is necessary to insure that safety standards or requirements are being observed or met. In some systems the enforcement function is related directly to the promulgation of standards or requirements. Infractions of the rules are often detected through safety inspections which focus on compliance or noncompliance with specific standards. However, many organizations are conducting audits of operations. The implication of an audit is one of taking a broad look at all operations and all phases of an activity to detect problems or anomalies.

A safety audit might well detect potentially dangerous situations which might not be controlled by any specific safety requirement, and are to some extent by industry. However, current OCS statutes rely on facility inspections for enforcement. Audits are complementary to inspections and would be beneficial to evaluating the overall safety situation, while simultaneously monitoring compliance with specific safety requirements.

Emergency Procedures

All safety professionals recognize that perfection is a goal seldom attained. Therefore safety systems have to provide for control of losses in the event of unplanned events. This element must be addressed whether the safety management system serves an organization or a regulatory safety system. In the former case, the safety management system would primarily establish and control emergency procedures, while in the latter case this element would be more involved in determining and specifying the level and kinds of emergency activities needed, and who will provide them.

Safety Ombudsman Task

This element has received relatively little recognition in most safety circles. It is mentioned in one study of the Three Mile Island Nuclear Accident (Miller, 1979). The element relates to the fact that information about valid safety considerations can often be inhibited by on-the-job relationships and pressures. The idea of providing an unrestricted or unfettered channel for either internal or external communications on safety-related matters through the ombudsman concept is worth considering in the design of any safety management system. This concept may be particularly important in a regulatory body as an alternative to an adversarial relationship between the government and industry.

CONSIDERATIONS IN THE DESIGN OF A SAFETY MANAGEMENT SYSTEM

The recovery of offshore oil and gas involves a multitude of diverse activities, tasks, people, and organizations. These are brought together through different forms of contractual relationships so that legal considerations often become a significant factor in achieving safety. This is not unheard of in other industrial situations, but it becomes a far more significant force in the offshore industry because of the large number of organizations present in a confined area, and because of the different and relatively liberal theories encountered in maritime law.

Most safety activities have related to attempts to control or influence one of the three interrelated areas of system safety -- man, machine, and the environment. While it is possible to control some limited aspects of the environment for specific tasks, the general environment surrounding offshore activities is not readily controlled. Historically, most safety efforts have been directed at the machine: engineering skills have been used to make the machine or hardware as reliable, dependable, and trouble-free as possible.

While these efforts have often met with considerable success, they have not eliminated accidents. The Federal Aviation Administration's (FAA) licensing system for pilots of aircraft, the U.S. Coast Guard licensing systems for ship's officers, and the licensing of plumbers, electricians, and other critical trades by municipalities, are examples of attempts to control man in the safety equation. These attempts also generally show a degree of success. Overall, however, society has been much slower to sanction the control of "man" than they have the "machine", and such controls have only been permitted where the lack of control would lead to highly unacceptable consequences.

More attention needs to be paid to the "man" or "people" area to improve safety. One of the early authors on safety stated, "All accidents, no matter how minor, are the fault of organization (Heinrich, 1959). A recent safety assessment stated, "Any regulatory or standard setting activity is only part of the safety equation. -- The bottom line in safety is the degree of care exercised by individuals" (Bruggink, 1980). These statements do not exist only in theory. A variety of safety statistics indicate that the majority of all accidents are caused by human error, poor judgment, lack of skills or experience, or other human flaws. Only a fraction are caused solely by equipment or hardware failure. Of these, some can be related to improper design or selection of inadequate hardware -- which again reflects human failure. These general statistics are corroborated by studies of OCS accidents (Whitney, 1981).

A recent study of the costs and benefits of MMS regulations (Arthur D. Little, 1982) concluded that the costs expended by industry in complying with MMS regulations amounted to 1 to 4 percent of the cost of production. The study team also found indications that the MMS regulations have not contributed significantly to reducing operational risks. Other relevant study findings were:

- o The investigators were unable to tell if the large body of regulatory requirements now in effect are cost effective;
- o The effect of using experienced employees is a reduction in the probability of people injury;
- o Considerable overlap occurs between rules which require essentially good management practices and those which require "safe" practices; and
- o Regulations that mandate good engineering practice are most effective and the least time consuming while those requiring extensive reporting and planning are least effective.

Irrespective of the results of the benefit-cost study, a well-managed and more efficient system is likely to be more effective.

Another factor that must be considered in the design of an overall safety management system is that all personnel accident statistics consistently show that of all reported injuries, between 20 percent and 33 percent relate to back injuries. Safety professionals usually estimate that 25 percent or more of injuries are back related. Many such injuries cannot be eliminated by conventional safety engineering activity. In a plant where workers perform highly repetitious activities, safety engineering can often improve or eliminate material handling tasks which strain the back. However, most heavy industries involving construction and other non-repetitive tasks, such as offshore oil and gas operations, have high incidence of back injuries. It follows, that to impact this large portion of the personnel injuries, attention will have to be given to the person who is involved. Training aimed specifically at reducing back-related injuries may be necessary.

GENERAL STRATEGIES OF SAFETY MANAGEMENT

It is useful to consider the strategies available to a regulatory body in achieving safety in a regulated industry or organization.

Some of the older traditional regulatory efforts have been directed at the licensing of personnel, or control of the human element. Since these methods have achieved some success, they might be retained in whole or in part. However, there has been little effort to control the upper levels of the human problem, i.e., management.

If safety is an inherent part of good management, then the regulatory body should be looking closely at the management of the organizations which it is regulating. The elements of a safety management system in Table A-1 might be used as a guide in evaluating the management of a regulated operation. If the management being regulated is addressing a majority of those elements, even though not by the same name it might be assumed that the regulated organization at least has a start on providing safe working conditions. They may need help or advice on the details, but are headed in the right general direction. If however, the regulated management is missing or ignoring most of the elements, then no amount of detailed information or help on engineering, personnel safety, or hazard identification is going to make much difference. In such cases, it is management itself which must be changed.

Further, a positive safety attitude throughout an organization is fundamental, and such an attitude cannot exist without management approval. With this in mind it appears reasonable to believe that one of the more fundamental methods of regulating safety involves the evaluation of, and where necessary, the changing of the management being regulated. It is necessary, however, to have an objective means of evaluating management. Since the concern is safety, an information system is needed to gather reliable data on safety, specifically on the number of accidents or incidents occurring within the sphere of individual regulated managements.

The Coast Guard is taking a major step in establishing such an information system related to their own areas of regulatory interest, with the specific intent of focusing their efforts on poorly performing management. The extension of this system, or development of a parallel system, might well be useful to the Minerals Management Service and other governmental agencies with responsibilities in offshore safety, as a means of evaluating management. The present proposed Coast Guard system does not include the collection of population or rate data. This is a deficiency which needs to be remedied to provide an objective measure of management performance -- in the area of safety.

It is worth reviewing the regulatory efforts involving control of hardware. The present MMS regulations tend to require certain general types of hardware, equipment, and systems under given circumstances. During MMS plan reviews and during offshore physical inspections, checks are made to insure compliance. The regulations are relatively detailed as to the installation and testing of systems. They also have special provisions for the extraction of sulphur, as opposed to oil and gas. If future operations should develop involving the recovery of other minerals, utilizing different kinds of technology

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and equipment, the present regulatory requirements would have to be augmented to address the hardware requirements of the technology involved. Thus, with the hardware approach to offshore safety, it is relatively certain that the expense of regulatory effort will continue to increase as the amount and types of offshore activity increase.

Reviewing the regulatory attempts to control the human element reveals that relatively few offshore personnel are licensed or certified. Those that are include the aircraft/helicopter pilots and a very limited number of ship/boat operators and officers. In addition to these, crane operators must meet minimal qualifications. Those with responsibility for well control must satisfy minimum training requirements, as must those who service certain critical valves.

While these requiremments are important, they do not address numerous other areas important to the general safety of the environment, personnel, and equipment. None of the existing regulations or requirements address the problem of minimal training/qualifications for the management level personnel making the decisions critical to offshore safety.

Although the oil and gas industry is generally recognized as having a very high degree of technical competence, this does not automatically insure that those individuals who directly control offshore operations are technically qualified or knowledgeable in safety management. One cannot manage what one does not understand. This was a fundamental weakness found in the review of the Three Mile Island nuclear accident (Miller, 1979).

Another regulatory strategy relies on industry consensus standards as a tool in requiring certain minimum levels of hardware, or of personnel performance (Gerwick, 1982). Consensus standards vary widely in content and purpose. Those addressing technologies may be quite specific and direct; those involving people and prescribing procedures less so. There are several advantages to this strategy. Consensus standards provide the regulatory body with a technical reference which can be updated without rewriting the regulation. The regulations permit some flexibility as long as the standards are met.

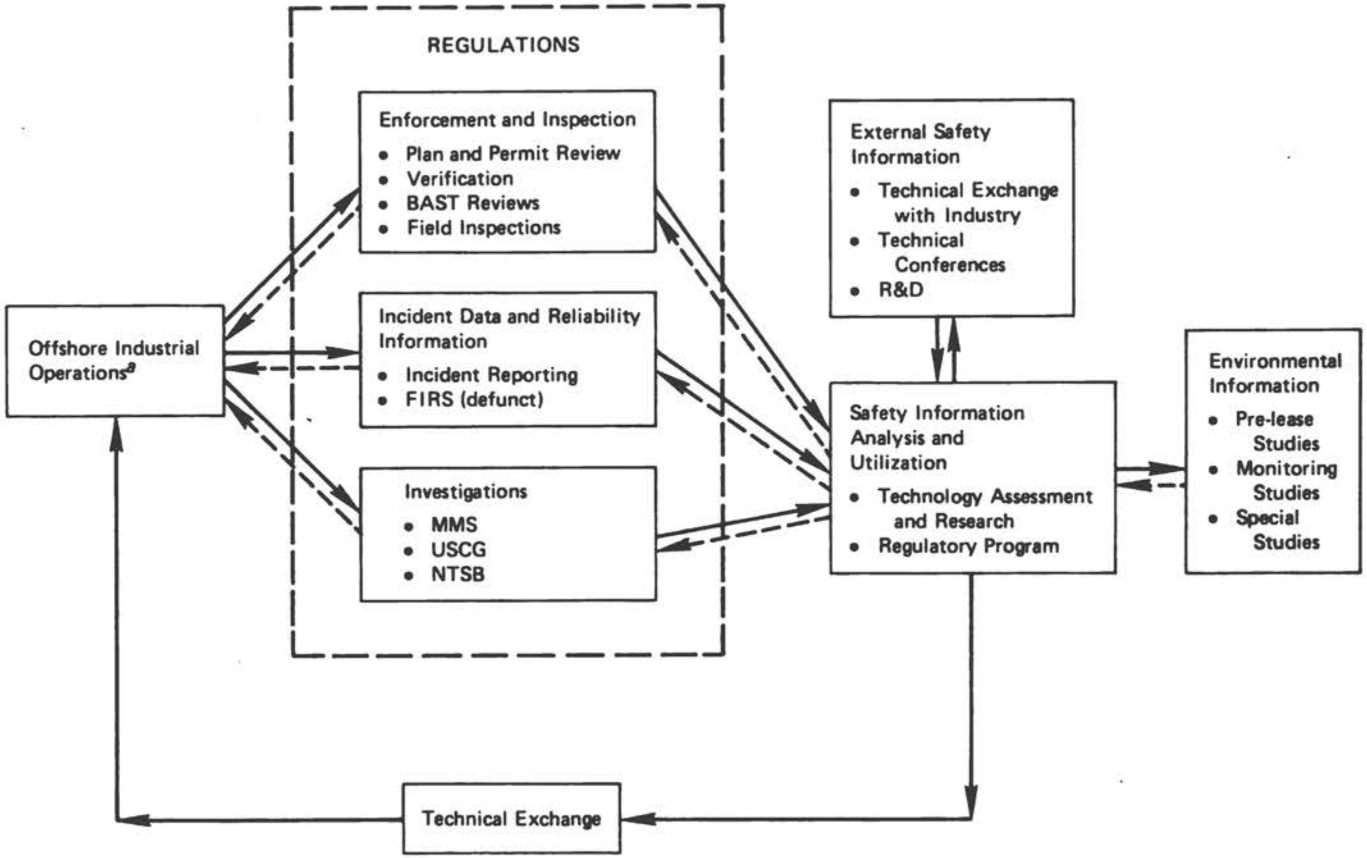
To summarize the above observations covering the strategies of safety management available to a regulatory body, it is apparent that regulatory requirements for hardware are sometimes useful and workable, i.e., they contribute to safety. Also, regulatory requirements involving personnel are useful but have been used in the offshore oil and gas activities in a relatively limited manner. Further, such "people" requirements as do exist refer mostly to workers, rather than to managers. The application of minimum requirements for training, knowledge, and performance at a managerial level could have a potentially more powerful effect on the regulated activity, than simply expanding the present limited regulations directed at the workmen.

A SAFETY MANAGEMENT SYSTEM FOR THE MINERALS MANAGEMENT SERVICE

This section considers the various identified elements of a safety management system in light of the specific responsibilities of the Minerals Management Service to manage, enhance, and regulate safety on the outer continental shelf. Figure 2 charts the existing flow of OCS safety information in the MMS. It is easy to recognize that the chart contains some of the functions and activities which have previously been identified as elements in a safety management system. For example, the "Enforcement and Inspection" block can be identified with the elements: Safety-Related Requirements and Enforcement Safety Audit. The "Investigations" block can be related to the element: Accident/Incident Investigation. The "Safety Information Analysis and Utilization" block could be identified with the elements: Hazard Identification and Analysis and Safety Planning. The elements of Attitude Development and Emergency Procedures cannot be as easily located on the flow chart.

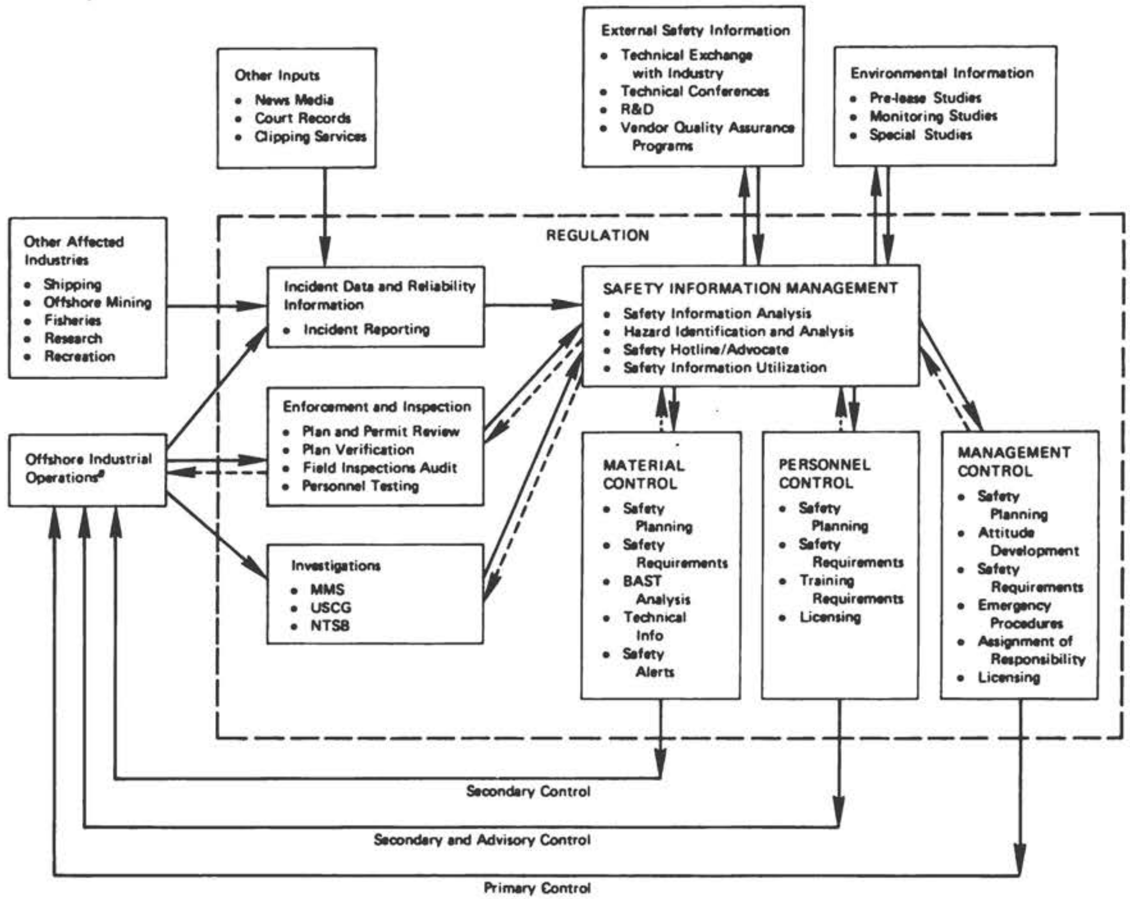
Since Figure 2 contains a number of the previously identified elements of a safety management system, it is possible to augment it with some of the missing elements to produce a flow diagram for safety information appropriate to a regulatory process. Figure 3 contains most of the elements of a safety management system. Several elements of safety management systems still do not appear on Figure 3. The Guidance element is conspicuous by its absence. Another element, Resolution of Perceived Hazards also is not shown. This latter element is essentially a monitoring process to insure that any identified possible or probable hazards are properly resolved, handled, controlled, or rejected as not pertinent. It seems reasonable that this monitoring or control process be combined with or included in the element of "Guidance." It is possible to represent this combined guidance function on the flow chart diagram by placing a circle near the center of the regulatory functional blocks and showing a control line to each functional block indicating a central control function. The circle could be labeled "Guidance" with a subelement, "Resolution of Perceived Hazards." However, the flow chart of Figure 3 is already complex. There is little to be gained by complicating the chart further, as long as it is recognized that these functional blocks must be coordinated and controlled.

While Figure 3 contains all of the elements of a safety management system, it also represents a significant complication of the existing safety regulatory system which might well result in additional requirements and reporting demands on the regulated industry. However, additional control directed toward the management of the regulated industry could possibly permit the withdrawal or minimization of regulatory requirements. It could, for example, reduce the plan submission and approvals which now tend to substitute governmental management for industry control. By requiring the regulated management to perform generally recognized good management functions, the regulatory agency can reduce the number of such functions which it is attempting to



[a] Includes structures (fixed and floating); floating vessels (crew and supply boats; construction, pipelay, and crane barges); machinery and pressure vessels; drilling and production operations; support and logistics activities; offshore construction (including pipelaying operations); diving; pipeline operations; aircraft; and environmental control and cleanup.

FIGURE 2 Current OCS safety information flow diagram.



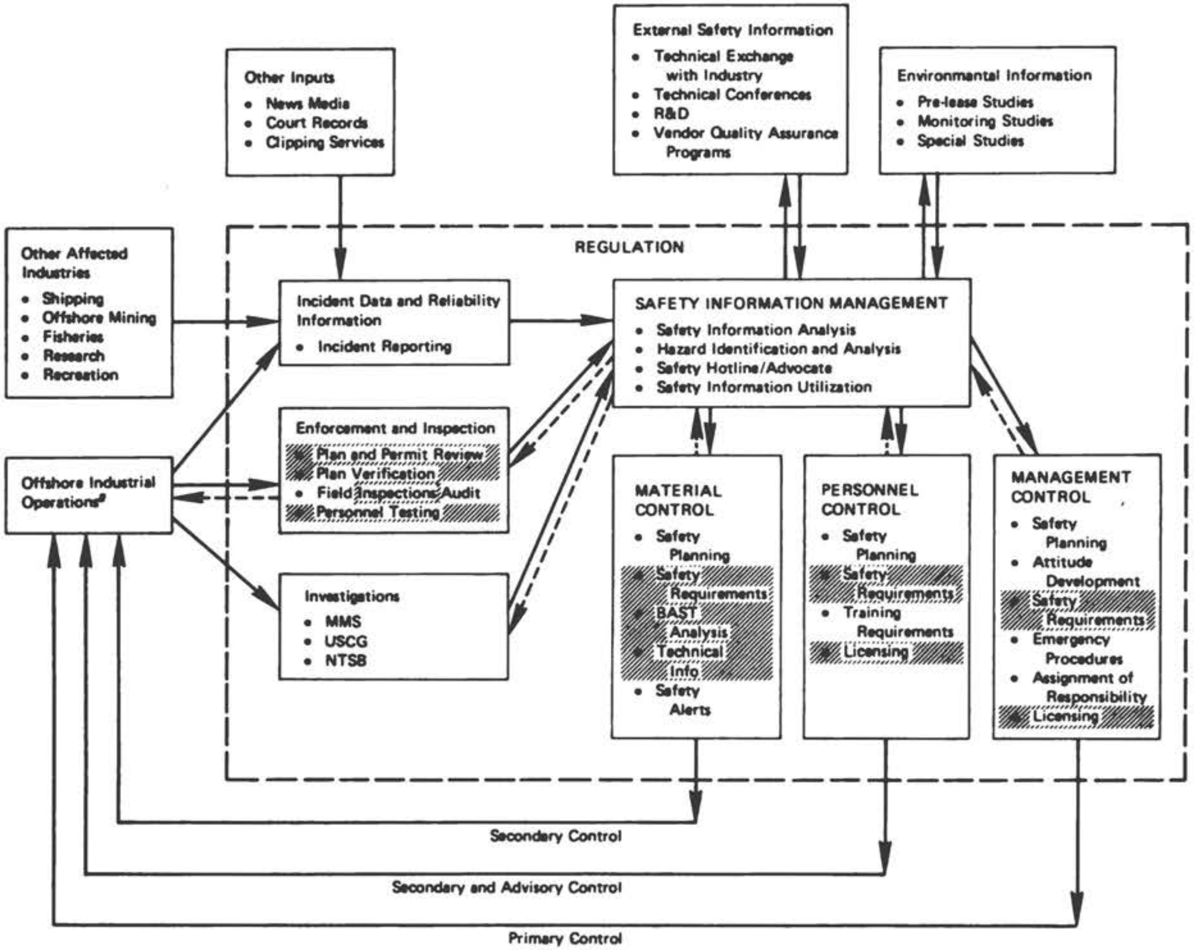
a Includes structures (fixed and floating); floating vessels (crew and supply boats; construction, pipelay, and crane barges); machinery and pressure vessels; drilling and production operations; support and logistics activities; offshore construction (including pipelaying operations); diving; pipeline operations; aircraft; and environmental control and cleanup.

FIGURE 3 Elements of an OCS safety management system.

carry out for industry. Whatever changes are made, it is important that there be a reasonably smooth and understandable transition, to avoid confusing the current regulatory process, and in the end doing more harm than good.

If such changes were made, the OCS safety management information flow would begin to look like Figure 4. The cross-hatched areas show activities or functions which might be minimized or eliminated at a later date. Figure 4 shows a change in semantics from "field inspections" to "field audit" to indicate a change in emphasis from detailed hardware inspection to an audit of the controls and procedures in place in the field.

The information flow charts that have been presented are not intended to be organization charts. However, they enable the testing of organization charts (and proposed reorganizations) against the elements of safety management systems to determine coverage, and the optimum use of available personnel and resources for safety management and safety information management.



[a] Includes structures (fixed and floating); floating vessels (crew and supply boats; construction, pipelay, and crane barges); machinery and pressure vessels; drilling and production operations; support and logistics activities; offshore construction (including pipelaying operations); diving; pipeline operations; aircraft; and environmental control and cleanup.

FIGURE 4 Elements of an OCS safety management system.

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APPENDIX B

DESCRIPTION AND ASSESSMENT OF THE MINERALS MANAGEMENT SERVICE SAFETY PROGRAM COMPONENTS

The committee reviewed the authorities and activities of the Minerals Management Service (MMS), as has been described. From this, it identified those MMS activities which it considered to be safety-related (see Table B-1). It also developed guidelines for assessment of the various program components. These are presented in Table B-2. The remainder of this section is keyed to Table B-1, and describes and assesses the program components.

TABLE B-1 Minerals Management Service Safety Program Components

1.0 Best Available and Safest Technology (BAST)

1.1 Technology Assessment and Research Program
1.2 BAST Program
1.3 BAST Certification Requirement

2.0 Exploration and Development

2.1 Exploration Plan, Development Plan, and Environmental Report
2.2 Oil Spill Contingency Plan

3.0 Platforms

3.1 Verification Program
3.2 Verification Documentation Requirement
3.3 Application for Installation of Platform
3.4 Oceanographic, Meteorological, and Performance Data

4.0 Drilling

4.1 Application for Permit to Drill
4.2 Evidence of Fitness of Drilling Unit
4.3 Shallow Hazards Survey
4.4 Hydrogen Sulfide (H_2S) Plan
4.5 Sundry Notice
4.6 Safety of Floating Operations
4.7 Critical Operations Plan
4.8 Well Control Training Program

5.0 Production

5.1 Safety System Design
5.2 Simultaneous Operations Plan
5.3 Welding Plan
5.4 Quality Assurance Program
5.5 Subsurface Safety Device Records
5.6 Surface Safety Device Records
5.7 Failure Inventory and Reporting System
5.8 Erosion Control Report

6.0 Pipelines

6.1 Application and Data

TABLE B-1 Minerals Management Service Safety Program Components (cont'd)

7.0 Enforcement

- 7.1 Inspection
- 7.2 Civil Penalties

8.0 Accidents

- 8.1 Accident Report
- 8.2 Reports of Spills of Oil and Liquid Pollutants
- 8.3 Events File
- 8.4 Accident Investigations

TABLE B-2 Guidelines for Assessing Minerals Management Service Safety Program Components

Missions

- o Motivate industry (i.e., leaseholders, operators, employers) to conduct operations safely (i.e., environment, worker safety, structural safety).
- o Monitor, audit, document, and publicize safety performance (i.e., pollution, structures and equipment, leaseholders, operators, employers, workers).
- o Foster the development and application of technology.
- o Insure that inconsistent or duplicative requirements are not imposed.

Means of Fulfilling Missions

- o Require that (system) safety programs and plans be developed and implemented by operators and employers.
- o Utilize performance approach to regulation (to promote technology development).
- o Establish goals for safety performance.
- o Safety performance analysis and feedback (e.g., investigate accidents, publish performance records).
- o Provide incentives (positive and negative) to operators and employers to meet safety goals and improve safety performance.

Programmatic considerations

- o Addresses statutory objectives
- o Meets a clear need
- o Fills a gap in coverage
- o Enforceable
- o Makes "the record" public
- o Computerize input/output; computer updates; interactive data bases
- o Timeliness

TABLE B-2 Guidelines for Assessing Minerals Management Service Safety Program Components (cont'd)

Systematic considerations

- Not redundant or burdensome
- Accessible (user friendly)
- Contributes to hazard identification or resolution; identifies cause
- Contributes to enforcement
- Analysis and utilization of safety information (feedback)
- Does it need other information to be useful?

1.0 Best Available and Safest Technologies (BAST)

1.1 Technology Assessment and Research Program

1.1.1 Objective: To provide MMS with the technological insight needed for regulating offshore operations and for assuring public safety and pollution prevention.

1.1.2 Reference: n.a.

1.1.3 Description: Technology assessment projects are conducted to determine, analyze, and compare the state-of-the-art practice and knowledge, and to identify technology gaps or possible improvements for further study: for example, assessment of the technology used in estimating the quantity of hydrocarbons lost for purposes of determining royalties from oil and gas lost during a blowout. Research projects are undertaken to quantify the applicability of technologies to MMS operational needs, and to pursue joint industry/government technology development projects. Generic research categories include well control, oil spill containment and cleanup, structural dynamics, structural inspection and monitoring, geotechnics, ice mechanics, materials, and risk assessment.

1.1.4 Use Made of Item: Projects in support of BAST program objectives, and to improve MMS operational capability.

1.1.5 Assessment: The Technology Assessment and Research Program supports and fosters the development and application of safety-related requirements technology. Funds are expended toward improving the knowledge and performance of MMS personnel or for filling gaps in research which are perceived as critical to safety. This effort is important to support the BAST program.

1.2 Best Available and Safest Technologies (BAST Program)

1.2.1 Objective: To ensure the application of technology in the form of equipment, systems, procedures, and trained workers to ensure the highest degree of operating safety and reliability, with consideration of the costs involved.

1.2.2 Description: The BAST program assesses and analyzes technology needs. It provides a coordination framework for exchange of technology information among MMS personnel. Through a system of headquarters and field committees, operational problems are identified and targeted for technology assessment and possible research. The committees also strive to assure that OCS regulations reflect state-of-the-art technology. The information flowing through these committees concerns the following:

- Maintaining familiarity and understanding of state-of-the-art technology, technology advances, and technology alternatives.

    - Identifying current and potential problem areas.

    - Identifying known or suspected operational deficiencies.

    - Pointing out the need for new or revised orders, standards, or regulations.

1.2.3 Reference: OCS Order No. 5, Sec. 1; Outer Continental Shelf Lands Act (OCSLA) Sec. 21(b).

1.2.4 Use Made of Item: See above.

1.2.5 Assessment: See 1.3.5

1.3 BAST Certification Requirement

1.3.1 Objective: To determine that the operator is using the best available and safest technology (BAST).

1.3.2 Description: The lessee is required to state that BAST is to be employed. BAST is in use if the lessee adheres in all respects to OCS orders, or has MMS approval for specific items of noncompliance.

1.3.3 Reference: OCS Order No. 5, Sec. 1.

1.3.4 Use Made of Item: BAST endorsements are included in exploration and development plans. In Alaska, and other cold regions, BAST includes evidence that equipment and materials are suitable for operation during freezing conditions.

1.3.5 Assessment: The BAST program and certification requirement address the missions of motivating industry, monitoring safety performance, and fostering the development and application of available technology. They are responsive to the 1978 Amendments to OCSLA. The exchange of technical knowledge within MMS is appropriate to the implementation of the BAST requirement. This program and requirement provide an opportunity for MMS to foster and spread the newer, safer, and more productive technology among members of the industry, particularly the smaller operators.

2.0 Exploration and Development

2.1 Exploration Plan, Development and Production Plan, and Environmental Report

2.1.1 Objective: To evaluate the environmental and economic impact of OCS drilling and development.

2.1.2 Description:

Exploration Plan - Identifies potential hydrocarbon accumulations and wells to be drilled to evaluate the accumulation in the entire leased area. Includes proposed type and sequence of exploration activities with a tentative timetable for execution; description of drilling vessel, platform, or other equipment to be attached to the seabed indicating safety and pollution control features; types of geophysical equipment to be used; approximate location at each proposed exploratory well; and current structure maps and schematic cross sections.

Development and Production Plan - Provides for the effective and efficient development and production of all known accumulations of commercially exploitable hydrocarbons. Includes description of the specific work to be performed; description of drilling vessels, platforms, pipelines, or other installations to be used; locations and depths of proposed wells; geological and geographical data; description of environmental safeguards and safety standards to be met; and expected rate of development and production and a time schedule for activities.

Environmental Report - Accompanies exploration, development, and production plans. Provides information for assessing the direct effects on the environment as a result of implementing the plans. Includes descriptions of the preparation for and response to oil spills, disposal of wastes, meteorological and oceanographic conditions, environmentally sensitive areas, offshore and land-based operations, and requirements for land, labor, material, and energy.

2.1.3 Reference: OCS Order No. 2, Sec. 1.1, and 30 CFR 250.34.

2.1.4 Use Made of Items: Plans are approved in writing and filed in the MMS district office. All operations are conducted under the provisions of approved plans. Plans also provide the basis for state findings of consistency with state coastal zone management programs.

2.1.5 Assessment: This program provides a broad range of administrative, technical, system-level and safety data to enable an evaluation of the intended effort. The program addresses statutory responsibilities of MMS, and the need to assess the environmental and safety risks. Development of the required material calls for a system-level approach by the operator and increases the probability of a safe and environmentally sound operation. The plans and reports address the problems of motivating industry and monitoring and documenting safety efforts.

2.2 Oil Spill Contingency Plan

2.2.1 Objective: Document operator's capability to respond to, contain, and clean up oil spills.

2.2.2 Description: The plan must show that the lessee/operator has available a full cleanup and removal inventory and is able to commit these resources in the event of an oil spill. The plan contains a description of procedures, personnel, and equipment to be used in reporting, cleanup, and prevention of a spread of any pollution. The plan contains provisions to assure that full resource capability, including accessiblity and capability of equipment of the lessee/operator, is known and can be committed during an oil spill.

2.2.3 Reference: OCS Order No. 7, Sec. 3.2.

2.2.4 Use Made of Item: The lessee is required to submit an Oil Spill Contingency Plan with or prior to submitting an Exploration Plan or a Development and Production Plan. The plan is reviewed and approved annually by the district supervisor. It is kept on file in the regional and district offices.

2.2.5 Assessment: The requirement for a contingency plan provides a means of requiring managers of regulated industry to act in a responsible manner. This objective could also be addressed by a performance standard.

3.0 Platforms

Fixed and/or bottom-founded platforms to be installed on the OCS require MMS approval of design, fabrication, and installation. In addition, mobile structures are reviewed to ensure that they have current U.S. Coast Guard or other appropriate certification and that site-specific conditions have been met. Platforms installed in the Gulf of Mexico in less than 122 meters (400 feet) of water are subjected to technical review by the Platform/Pipeline Unit of the Office of the Regional Supervisor, Rules and Production, MMS. Platforms for frontier areas, i.e., areas with unusual or extreme problems of environmental conditions, and platforms of unusual design and, in the Gulf of Mexico, in water depths greater than 122 meters (400 feet), are subjected to a comprehensive platform verification program and requirement to ensure structural integrity. Procedures for platforms requiring the approval of the MMS regional supervisor are described in item 3.1 below. The platform verification program is presented in item 3.2 below.

3.1 Installations Requiring Approval of MMS Supervisor

3.1.1 Objective: To review the design parameters of the structure and the foundation, including soil boring analysis and piling design.

3.1.2 Description: Provides supporting technical engineering information. All fixed and mobile drilling units must be able to withstand the oceanographic and meteorological conditions for the proposed area of operations.

3.1.3 Reference: OCS Order No. 2, Sec. 2.1, and OCS Order No. 8, Sec. 3.4.

3.1.4 Use Made of Item: Approval of the installation plan includes certification of a registered, professional, structural or civil engineer. The application is approved in writing. A copy of the transmittal letter is kept in the regional office.

3.1.5 Assessments: This program provides a monitoring of the design criteria and engineering effort which has been done in planning a new fixed structure. This has some marginal safety application in that it documents engineering effort, but it does little to validate or recheck the initial efforts made by the owner. The program should be questioned as to how much this function adds to safety of the platforms.

3.2 Platform Verification

3.2.1 Objective: To provide assurance of the structural integrity of fixed platforms through design review, especially of the adequacy of design criteria and the conformance of engineering designs to criteria.

3.2.2 Description: Design documentation that is submitted for review and approval comprises (1) general platform information, (2) environmental and loading information, (3) foundation information, and (4) structural information, and includes design drawings and material specifications for primary load-bearing members included in the space-frame analysis, the certification by the lessee, and the name of the registered professional engineer. Verification documentation is submitted in three stages: a design verification plan, a fabrication verification plan, and an installation verification plan. Each of these plans nominates the certified verification agent (CVA), details the qualifications of the CVA, and how CVA certification is to be accomplished at each phase.

3.2.3 Reference: OCS Order No. 8, Sec. 3.

3.2.4 Use Made of Item: The design plan is submitted with or subsequent to submittal of the Exploration Plan or the Development and Production Plan. The verification plans are then submitted sequentially prior to the commencement of each phase of constructon of the platform (design, fabrication, installation). The data submitted are reviewed and retained by the Platform Verification Section. The data enables the regional managers to review and critique proposed structural approaches incorporated in exploration and development plans. It also enables the managers to insure that actual platform installations, major structural modifications, and repairs comply with these plans and with good engineering practices.

3.2.5 Assessment: This program addresses the missions of monitoring safety practices and motivating industry to operate in a highly responsible manner. The program is consistent with the idea of using qualified third party individuals to audit and check the design of new structures. This fosters the use of adequate engineering research and design practices, and discourages short cuts and skimping which could lead to accidents. This program has the potential of generating significant extra costs by essentially increasing the engineering costs on new or state-of-the-art designs. Care must be taken to insure a high degree of competence in the third party verification agencies, so as to control the verification costs.

3.3 Oceanographic, Meteorological, and Performance Data

3.3.1 Objective: To establish environmental criteria for design of OCS structures. Design criteria are approved based on evaluation of the data. Also, the data are used to monitor and evaluate the performance of structures under various weather and ocean conditions, and to determine requirements for air quality review.

3.3.2 Description: Where such information is not readily available, it is requested by the district supervisor. When requested to do so, the lessee is required to collect and report oceanographic, meteorological, and performance data during the period of operation.

3.3.3 Reference: OCS Order No. 2, Sec. 2.4.

3.3.4 Use Made of Item: See Objective. Copies of these reports are kept in the regional office.

3.3.5 Assessment: The program attempts to collect information which has a bearing on the structural performance and safety of structures. The progam tends to assist MMS in evaluating new installations, and to this extent may be worthwhile.

4.0 Drilling

4.1 Application for Permit to Drill, Deepen, or Plug Back (Form 9-331C).

4.1.1 Objective: For the district supervisor to evaluate and approve the proposed operation in support of the prior approved Exploration and Development Plans.

4.1.2 Description: Provides supporting technical and engineering information about drilling operations (see item 4.2 - 4.4).

4.1.3 Reference: OCS Order No. 2, Sec. 1.2, and 30 CFR 250.36.

4.1.4 Use Made of Item: Plans are approved by the district supervisor based on consistency with accepted engineering practices. Forms and supporting information are in the district office.

4.1.5 Assessment: The application, with supporting data, is a significant engineering/safety milestone. The requirement to furnish supporting data can be viewed as burdensome, if such data are not used by MMS; alternatively, supporting data could be made available on request.

4.2 Evidence of Fitness of Drilling Unit to Perform the Planned Operation

4.2.1 Objective: To evaluate the capability of the drilling rig to perform the planned drilling operation within an acceptable margin of safety.

4.2.2 Description: Evidence of the fitness of a drilling unit to perform planned operations is submitted as part of the Application for Permit to Drill (APD) (Form 9-331C).

4.2.3 Reference: OCS Order No. 2, Sec. 2.2.

4.2.4 Use Made of Item: See 4.1.

4.2.5 Assessment: The application of the requirement to fixed platforms is appropriate. There is some question as to whether application of the requirement to mobile offshore drilling units duplicates engineering reviews done during American Bureau of Shipping classification or Coast Guard certification.

4.3 Shallow Geologic Hazards Survey Report and Data

4.3.1 Objective: To assist in preparing (1) an Environmental Geologic Report for inclusion in environmental assessments of proposed lease sales and (2) a Shallow Geologic Hazards Report for the district office to use in APD approval or disapproval.

4.3.2 Description: Included as part of the APD (Form 9-331C).

4.3.3 Reference: OCS Order No. 2, Sec. 2.3.

4.3.4 Use Made of Item: Shallow hazards data are circulated as appropriate within MMS and to operators. The plan is approved in writing. A copy is filed at the district office.

4.3.5 Assessment: This shallow hazards survey is used by the MMS to verify any conflicts in drilling depths that would interfere with adjacent drilling areas. Although such conflicts are infrequent, the check is important and should be retained.

4.4 Hydrogen Sulfide (H_2S) Contingency Plans

4.4.1 Objective: To review operations for safety and for compliance with regulations.

4.4.2 Description: Drilling operations in some locations have encountered H_2S which can be fatal if inhaled. The plan describes preventive measures to avoid H_2S emergencies, and operating practices in the event of them.

4.4.3 Reference: OCS Order No. 2, Sec. 8.

4.4.4 Use Made of Item: The H_2S Contigency Plan is submitted simultaneously with the APD (Form 9-331C) for wells to be drilled in potentially H_2S-prone areas. The plan is approved along with Form 9-331C, and a copy is kept on file in the district office.

4.4.5 Assessment: Encounters with H_2S can lead to catastrophic emergencies. The plan clearly documents that the lease operator has considered the emergency and developed contingency actions. The severity of the hazard justifies the existence of the requirement.

4.5 Sundry Notice including Abandonment of Wells (Form 9-331)

4.5.1 Objective: To determine compliance of drilling production operations with OCS orders.

4.5.2 Description: Notices, which consist of technical and engineering descriptive material demonstrating compliance with OCS orders, are filed before work such as abandonment of a well is undertaken, and after the work is completed. Written approval of Form 9-331 must be received before operations can commence.

4.5.3 Reference: OCS Order No. 3, Sec. 1, and 30 CFR 250.92(b) (3) (4).

4.5.4 Use Made of Item: Sundry notices are reviewed to establish the type of work proposed and compliance with OCS orders. Sundry notices are submitted wih an original and three copies. The original and attachments are filed in the district office, one copy is sent to the MMS regional office, an approved copy is returned to the operator, and the last copy is for public record.

4.5.5 Assessment: Documentation of compliance with OCS orders is justified. Alternatively, such documentation could be required to be kept by the operator and provided to MMS on request.

4.6 Program Providing for Safety of Floating Drilling Operations

4.6.1 Objective: To insure safety in floating drilling operations. Operations from floating drilling vessels require drilling through a marine riser for circulation of drilling fluids. Formation competency at shallow depths sometimes is not adequate to permit circulation to the vessel. Special drilling procedures are necessary in these situations.

4.6.2 Description: The operator must submit all known pertinent information including seismic and geologic data, water depth, drilling-fluid hydrostatic pressure, a schematic diagram indicating the equipment to be installed from the rotary table to the proposed conductor-casing seat, and a contingency plan for moving off location.

4.6.3 Reference: OCS Order No. 2, Sec. 5.4.2.

4.6.4 Use Made of Item: Programs are reviewed. Copies are maintained in the regional office.

4.6.5 Assessment: The requirement is justified. An alternative means of achieving the objective would be to require that operators have a program and that the program be made available to the MMS on request for review.

4.7 Critical Operations and Curtailment Plan

4.7.1 Objective: To review operators' policies and procedures for handling certain operations performed during drilling with respect to well control, and for the prevention of fires, explosions, and oil spills. These include operations such as: (1) drill stem testing, (2) setting casing, and (3) logging or wireline operations.

4.7.2 Description: The operator identifies the specific critical operations likely to be conducted and describes the circumstances or conditions under which these operations will be ceased or limited. The operator must review the plan annually.

4.7.3 Reference: OCS Order No. 2, Sec. 9.

4.7.4 Use Made of Item: The plan is submitted with the Exploration Plan or Development Plan. It is reviewed by district drilling engineers, approved by the district engineer, and kept on file in the district office.

4.7.5 Assessment: The requirement for preparation of advance plans to cope with various emergencies is valid and addresses safety concerns. The requirement for submitting copies of the plan which are then filed raises questions as to how effective the program is in implementing safety. An alternative safety strategy would require that plans be prepared and made available to MMS on request.

4.8 Well Control Training Program

4.8.1 Objective: To provide for the qualifications of drilling personnel in well-control equipment, operations, and techniques to ensure safety and to prevent pollution during drilling operations.

4.8.2 Description: Lessee and drilling contractor personnel must be trained and qualified in accordance with MMS standards. MMS approves the curricula of well control training schools. Any driller, toolpusher, or operator's representative who was trained in well control operations between December 1, 1975, and December 1, 1979, is credited with having met the federal training requirements. To maintain qualification, such personnel must successfully complete a MMS-approved refresher course annually and repeat the basic well-control course every four years.

4.8.3 Reference: OCS Order No. 2, Sec. 7.3.

4.8.4 Use Made of Item: Records of the training of personnel are maintained at the drill site.

4.8.5 Assessment: The curriculum approval and course attendance requirements motivate industry and document the training (and presumably the capability) of employees. More vigorous means of documenting worker capability include MMS review/criteria of student performance at well control schools; and/or on-the-job tests witnessed by MMS inspectors.

5.0 Production

5.1 Submittal of Safety-System Design and Installation Features

5.1.1 Objective: To determine whether production safety system facilities are in compliance with OCS orders and American Petroleum Institute (API) recommended practices.

5.1.2 Description: The lessee is required to submit and receive district approval of safety-system design features prior to their installation. Information submitted includes that which is relative to design and installation features of all surface-production safety systems including schematic floor diagrams, safety analysis function evaluation (SAFE) charts, and schematic piping diagrams. A required element is certification that the designs for the mechanical and electrical system were approved by registered professional engineers.

5.1.3 Reference: OCS Order No. 5, Sec. 4.4.

5.1.4 Use Made of Item: A district production engineer reviews the information. One complete set of the submittal is kept in the district office for reference. A second set is filed in the regional office. A production technician may make an on-site inspection to verify compliance with approved submittals.

5.1.5 Assessment: The SAFE chart and schematic diagrams of piping are key safety items, which require MMS approval, and which should be on file at MMS. Other documentation accompanying the submittal should be reviewed from the standpoint of requiring that documentation be made available to MMS on request.

5.2 Simultaneous Operation Plan

5.2.1 Objective: To provide a means for evaluating safety and compliance with OCS orders when workover, wireline, pumpdown, and major construction operations are to be conducted simultaneously with production.

5.2.2 Description: Prior to conducting simultaneous operations, a plan must be submitted to and approved by the district supervisor. The plan includes a narrative description of operations and procedures for mitigating potentially undesirable events.

5.2.3 Reference: OCS Order No. 5, Sec. 5.3

5.2.4 Use Made of Item: The plan is approved in writing and filed with the district supervisor.

5.2.5 Assessment: The potential hazards of simultaneous operations justify this requirement.

5.3 Welding, Burning, and Hot Tapping Plan

5.3.1 Objective: Enables review of operations for compliance with OCS orders and industry-recommended practices.

5.3.2 Description: Each lessee is required to file a Welding, Burning, and Hot Tapping Plan with the district supervisor. The plan must contain qualification standards for personnel and the methods by which the lessee will assure that only qualified personnel are used. The plan also contains a drawing to identify the facility's safe welding areas. All welding or burning not done in a safe welding area must be performed in accordance with certain procedures.

5.3.3 Reference: OCS Order No. 5, Sec. 5.4 through 5.4.3.

5.3.4 Use Made of Item: The information required to be submitted as a part of this plan is used by the production engineer to review the proposed operation for compliance with OCS Order No. 5. Maintenance of welding plans allows the inspectors to monitor for compliance. The plans are approved in writing and filed in the district office. A copy of the plan is to be available in the field area.

5.3.5 Asssessment: With the many types of welding and different applications of welding methods, it is sufficient to maintain the welding plan on the OCS installation, and to make it available for MMS review on request.

5.4 Quality Assurance (QA) Program

5.4.1 Objective: To work closely with the American Society of Mechanical Engineers (ASME) and API in amending standards or developing new standards, and to ensure that safety and pollution prevention equipment conform to quality assurance standards (ANSI/ASME-SSPE 1 and SSPE 2).

5.4.2 Description: The program applies to the installation of surface and subsurface safety valves on offshore production structures. MMS certifies valve manufacturers that meet ASME and API standards. Only the valves of certified manufacturers can be used by lessees.

5.4.3 Reference: OCS Order No. 5, Secs. 2 and 3.

5.4.4 Use Made of Item: Operators are required to keep records on the installation, repair, and replacement of surface and subsurface safety valves. Records are checked during inspections.

5.4.5 Assessment: The program verifies that equipment meets standards, and fosters reductions in manufacturing defects. The certification by the operator that equipment under the program meets the standards of the program is redundant to some extent with the certification of the equipment manufacturer that its products meet the standard.

5.5 Subsurface Safety Device Records

5.5.1 Objective: To verify performance of key safety devices.

5.5.2 Description: Records on installation, maintenance, testing, and use are maintained by the lessee for at least 5 years.

5.5.3 Reference: OCS Order No. 5, Sec. 3.11.

5.5.4 Use Made of Item: When the Failure Inventory and Reporting System (FIRS) (see 5.7) was in place, this information was used as a check on FIRS data. Records are available for MMS inspection.

5.5.5 Assessment: The importance of the safety devices merits the requirement. The provisions of the requirement for MMS audit versus operator submission of data for MMS filing are exemplary and may provide a model for other MMS documentation requirements.

5.6 Surface Safety Device Records

5.6.1 Objective: To verify performance of key safety devices.

5.6.2 Description: Records of installation, maintenance, testing, and use are maintained by the lessee for at least 5 years.

5.6.3 Reference: OCS Order No. 5, Sec. 5.6 through 5.6.1.

5.6.4 Use Made of Item: When FIRS (see 5.7) was in place, this information was used as a check on FIRS data. Records are available for MMS inspection.

5.6.5 Assessment: See 5.5.5.

5.7 Safety Device Failure and Inventory Reporting System (defunct)

5.7.1 Objective: To enhance reliability and safety through development of reliability data on key safety devices.

5.7.2 Description: Periodic inventory and failure reports were submitted on safety and pollution prevention devices on offshore structures, including satellites and jackets, which produce or process hydrocarbons, and the hydrocarbon pipelines thereon. Devices included blowdown valves, burner flame detectors, check valves, combustible gas detectors, emergency shutdown valves, level sensors, pressure sensors, relief valves, shutdown valves, subsurface safety valves, surface safety valves, temperature sensors, valve actuators, and shutdown valves.

5.7.3 Reference: OCS Order No. 5, Sec. 6. Also see cancellation notice: Federal Register, April 30, 1982.

5.7.4 Use Made of Item: The program was cancelled because it involved substantial paperwork, with limited usefulness. FIRS data were intended to be processed for subsequent safety analysis, with industry-wide dissemination of reliability results, but the program never attained this level of implementation.

5.7.5 Assessment: Collection and dissemination of reliability data foster improvements in technology. The FIRS program duplicated industrial efforts in that companies normally keep records of safety equipment performance for maintenance and other purposes. A more efficacious involvement of the MMS in reliability would be the conduct of reliability studies using available industry data (see also 5.5 and 5.6).

5.8 Annual Report of Wells that have Erosion Control Problems and Results of Erosion Control Programs

5.8.1 Objective: To provide the MMS regional office with information necessary to evaluate and measure the effectiveness of erosion control measures and compliance with OCS orders.

5.8.2 Description: Lessees that have wells or fields having a history of sand production are required to have an erosion control program in effect to maintain the integrity or safety of production and safety systems. The program may include sand probes, X-ray, ultrasonic, or other satisfactory monitoring methods.

5.8.3 Reference: OCS Order No. 5, Sec. 5.1.11.

5.8.4 Use Made of Item: The reporting requirement provides a study of the results of erosion-control programs. Erosion control annual reports are reviewed by the production engineer and chief production technician, and filed in the district office. The annual report also is submitted by December to the appropriate regional office.

5.8.5 Assessment: This program monitors a safety-related matter involving the integrity and safety of production equipment. Requiring an erosion control program, when it is appropriate, is valid. However, to require a report which is reviewed and filed adds little to the implementation of safety.

6.0 Pipelines

6.1 Pipeline Applications and Data

6.1.1 Objective: To review the conformance to applicable industry standards and government regulations, and for shallow geologic hazards.

6.1.2 Description: Data and engineering specifications and drawings are provided. All pipelines are designed and maintained according to specific requirements.

6.1.3 Reference: OCS order No. 9, Secs. 1 through 3.

6.1.4 Use Made of Item: The data are submitted to the district supervisor for approval as a letter request for right of use and easement. Copies are maintained in the regional office. Hazards data are kept by the resource evaluation group.

6.1.5 Assessment: Pipelines must be constructed and installed according to various government and industry standards. This program should be reviewed to determine whether portions of it are redundant with other federal pipeline reviews and approvals.

7.0 Enforcement

7.1 Inspection Program

7.1.1. Objective: To insure compliance with MMS regulations, OCS orders, approved plans, and other approvals; to enhance operational safety and to minimize pollution.

7.1.2 Description: The MMS has nine districts, including five in the Gulf of Mexico, which oversee 95 percent of OCS field operations. The OCSLA requires that every OCS facility be inspected once each year. These announced inspections are completed in 9 months in the Gulf. Unannounced inspections are conducted in the remaining 3 months. In frontier areas, inspections are conducted more frequently. In some instances, MMS inspectors have resided on drill rigs during drilling operations.

In the Gulf, 45 field operations inspectors use 12 helicopters to visit the 2,850 platforms annually. It may take as long as 3 days to inspect a large platform or as little as 30 minutes to inspect a single well caisson. About half of the 2,850 structures in the Gulf have fewer than six wells.

There are 14 platforms in the Pacific Region and nine drilling units. Ten inspectors and two helicopters are employed in field inspections in the Pacific Region. Drilling operations are visited almost every day.

In Alaska, inspectors may reside on frontier drilling operations. At the peak of drilling operations in the Atlantic, three inspectors covered the area.

The objective of the inspection program is to enhance operational safety, minimize pollution, and ensure that operating rules are followed. Inspection includes all safety equipment designed to prevent or ameliorate blowouts, fires, spillages, or other major accidents. In 1982, a total of 7,000 site visits were made by inspectors; 5,500 citations, or INC (Incidents of Noncompliance with Operating Orders) were issued to operators. Most INCs, such as pilots out of tolerance, are easily corrected. Field inspectors have access to a platform inspection data base, which contains information about the platform, hours spent inspecting, violations, departures granted, safety device settings, pipelines, well bay operations, production vessels, and possible items of noncompliance. The data base contains settings of various safety devices and equipment, and items not in compliance with regulation. The data derive from prior field inspections.

7.1.3 Reference: 43 USC 1348

7.1.4 Use Made of Item: Inspections are conducted by means of standard checklists. Copies of the checklist are maintained by the MMS and are provided to the OCS installation and the operator's responsible field office. Incidents of noncompliance and potential incidents of noncompliance are noted, followed up on, and provide the basis for enforcement actions which may include suspensions in operations or civil penalties (see item 7.2).

7.1.5 Assessment: The inspection program meets a clear enforcement need and contributes to safety performance by assuring that required safety equipment is installed and procedures used. The inspection program may be viewed as a negative incentive because it highlights breaches in performance, rather than successes, but good inspection records could also be used in a motivational framework -- letters of commendation could be sent to good performers, or good performers could be inspected less frequently than poorer performers. Copies of inspection records also could be sent to contractors who, in drilling especially, may play a major role. The inspection data base could be modernized to facilitate identification of trends in the performance of structures and equipment.

7.2 Penalties Program

7.2.1 Objective: To help improve the safety of personnel and equipment engaged in OCS oil and gas operations, to protect the quality of the marine environment, and to encourage prompt and efficient exploration and development.

7.2.2 Description: Oil and gas operations on the OCS are to be conducted in accordance with applicable federal laws, regulations, and orders. In addition to criminal penalties, the MMS can further prompt operators, lessees, and permittees to comply voluntarily with legal requirements through civil penalties. In the case of the OCS field inspection program, civil penalties may be imposed when traditional enforcement actions -- warnings and shut-in orders -- have been or would be ineffective. In other matters, civil penalties are imposed only after the violator has had an opportunity to make amends. The MMS has the authority to assess and collect a civil penalty of not more than $10,000 for each day of noncompliance. However, the MMS is required to give potential violators written notice prior to issuing a citation.

Following is an account of civil penalties action through 1982.

TABLE 1 Civil Penalties Actions

	1980	1981	1982
Cases	12	12	30
Penalties Assessed	10	9	20
Collected	$394K	$353K	$388K

SOURCE: Minerals Management Service

The majority of these penalty actions were the result of repeat INCs as the result of inspection. Very few cases arise solely on the basis of the severity of a violation. A 1983 court ruling voided several penalties actions on the grounds that MMS failed to give potential violators sufficient notice. The civil penalties regulations are being revised in accordance with the court ruling. The civil penalty provisions of OCSLA also apply to U.S. Coast Guard regulations under the OCSLA.

7.2.5 Assessment: In theory, the program assures that operators recognize that laws will be enforced. However, court challenges have limited the effectiveness of the program. While a penalty program is needed, penalties are a negative means of assuring operator compliance. Positive incentives, were they in place, could be as or more effective.

8.0 Accidents

8.1 Accident Report

8.1.1 Objective: To provide the necessary information for corrective and preventive actions to reduce or eliminate the likelihood of reoccurrence. The term "accident" includes oil spills as well as fires, personal injuries and death, structural failures, and other malfunctions.

8.1.2 Description: The lessee is required to file an accident report within 10 days of the date of occurrence. All lost-time accidents (72 hours or greater) are to be reported. The lessee must immediately notify the district supervisor of all serious accidents, any death or serious injury, and all fires. Discharges in violation of regulations are to be reported immediately.

8.1.3 Reference: OCS Order No. 7, Sec. 2.3, 30 CFR 250.45, 33 CFR 153.203.

8.1.4 Use Made of Item: Accident reports provide the basis for taking corrective or preventive actions, which may include issuance of a notice to lessee, shut-in, investigation, or revision to regulations.

8.1.5 Assessment: See 8.4.5.

8.2 Reports of Spills of Oil and Liquid Pollutants

8.2.1 Objective: To provide information for determining severity of spill and the need for investigation or change in practices.

8.2.2. Description: Incident data reported orally to the district supervisor and confirmed in writing. All reports must include the cause, location, volume of spill, and action taken.

8.2.3 Reference: OCS Order No. 7, Sec. 2.3.

8.2.4 Use Made of Item: Information gathered may be used in an investigation, or for recommending safe practices and preparing safety alerts.

8.2.5 Assessment: The collection of data about unplanned and unexpected events is a valid element of a safety management system. This program is redundant since the Coast Guard has concurrent responsibilities and has issued similar reporting requirements. Some coordination of effort is indicated among the responsible agencies (i.e., MMS, Coast Guard, EPA) to eliminate redundant effort and reporting requirements, while still insuring that each agency receives needed data in a timely way.

8.3 OCS Events File

8.3.1 Objective: To collect information about traumatic events that occur on oil and gas platforms in the Gulf of Mexico.

8.3.2 Description: The definition of a traumatic event includes an oil spill, a blowout, a fatality, an injury, a fire, or an explosion. File information contains the location, operator, type of rig, cause of event, and description of event.

8.3.3 Sources of Data: Accident reports.

8.3.4 Assessment: Regardless of what agencies are collecting data, a central file of OCS loss data is an essential element of an OCS safety management system. Currently, the Events File contains only Gulf of Mexico information; its coverage needs to be expanded to all OCS areas. The file lacks causal data, but some effort is being made to correct this inadequacy.

8.4 Accident Investigations

8.4.1 Objective: To gather all the necessary information to determine the causes of accidents, and to identify specific violations of regulations that may have occurred.

8.4.2 Description: Investigation and public report by MMS are required for fires, oil pollution, deaths, and injuries associated with oil or gas drilling or production operations and equipment, including hydrogen sulfide exposure. In addition, the agency investigates other incidents related to its regulatory purview which include loss of well control, sinking, capsizing, or major damage to a vessel or facility. The degree to which an accident is investigated is dictated by its severity.

MMS characterizes accidents as follows:

- Category 1: Equipment damage under $50,000 or structural damage under $100,000, or pollution of 6.3 barrels or less.
- Category 2: Equipment damage of $50,000-$100,000 or structural damage of $100,00-$1 million, or pollution of 6.3 barrels, or a minor blowout.

- o Catetory 3: Damage over $1 million, or death, or oil spill of 200 barrels or more, or major blowout.

While accident reports are filed on all categories of accidents, full investigations and public reports are prepared on category 3 accidents and some others, mainly vessel sinkings and blowout.

The MMS/USCG memorandum of understanding (MOU) assigns MMS the accident investigation lead for operational accidents such as fires, blowouts, and explosions. USCG has the lead for investigation of other kinds (i.e., maritime/workplace safety) of accidents. An annual report tallying OCS accident statistics is prepared.

When a category 2 or 3 accident occurs, an investigator is dispatched to the site as soon as possible. Also, MMS Headquarters is notified by phone. Catetory 1 accidents may not be investigated on site.

Category 3 investigations are conducted at the regional level. The MMS has found that legal procedures such as cross examination frustrate fact findings. They strive, therefore, to avoid excessive legal entanglement, though lawyers participate in accident investigations.

The MMS conducted 62 investigations in 1980, 47 in 1981, and 39 in 1982. Of these, only eight have been Category 3 investigations.

Accident investigations may lead to suggestions for changes in regulations, or identify particular safety concerns. These, in turn, may be publicized through the MMS Safety Alert System, which provides a safety bulletin to every OCS workplace (and others who request them).

8.4.5 Assessment: Accident reports and investigations are a significant element of a safety management system and satisfy the mission of monitoring ongoing events. The MMS has an accident reporting and investigation system in place. One weakness in the system may be difficulty in translating output into regulatory or other useful action. Although reports of near misses are difficult to obtain, and comprehensive investigation of all near misses is impracticable, MMS should consider the selective investigation of significant events or near misses to add to the general body of safety knowledge. Part of the present program overlaps Coast Guard reporting requirements as regards bodily injury and oil spill reporting. This overlapping area is being partly eliminated by regulatory action.

Accidents and the results of investigations ought to be widely publicized through safety alerts and possibly OCS summary reports -- this does not appear to be a substantive element of accident investigations.

APPENDIX C*

SUMMARY OF OUTER CONTINENTAL SHELF SAFETY INFORMATION DATA BASES

I. Occupational Safety and Health Administration (OSHA) Annual Survey (OSHA Requirements - 29 Part 1904 - Recording and Reporting Occupational Injuries and Illnesses)

A. Applicability

1. Each employer except "small employers" who have no more than 10 employees or establishments which conduct business primarily in one of the Standard Industrial Classifications (SICs) listed by OSHA. To be exempt from general record-keeping, the SIC must not be targeted for routine inspections and have a record of lost-workdays on account of injuries at or below 75 percent of the private sector for 1978-1980 as published by the Bureau of Labor Statistics (BLS). This latter exemption was implemented on December 28, 1982. Oil and gas is not on the exemption list.

2. Small employers and exempted SICs must continue to report fatalities and multiple hospitalization accidents to OSHA and participate in BLS' annual statistical program, if selected, by keeping OSHA Form No. 200 S for a year and reporting data at the end of the year on a special form under 200 S. (Note: 145,000 employers who would ordinarily be exempted from recordkeeping have been chosen for the 1983 survey.)

B. Recordkeeping requirements for nonexempted employers

1. Maintain at each establishment a log and summary (OSHA No. 200 or equivalent) of all recordable occupational injuries and illnesses for the establishment (enter data no more than 6 days after occurrence).

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*This background paper was compiled by the committee based on the findings of its study.

2. Complete OSHA Form No. 101 or equivalent (within 6 days after occurrence) supplemental record of each recordable occupational injury or illness.

3. Post annual summary of occupational injuries or illnesses at each establishment from February 1 to March 1 each year.

4. Retain records for 5 years following end of year to which they relate.

5. Make all records available to OSHA inspectors and representatives of the U.S. Department of Health and Human Services (HHS). Make OSHA Form No. 200 S available to current and former employees and to their representatives.

6. Participate in BLS statistical program if selected by completing Occupational Injuries and Illnesses Survey Form.

C. Definitions

1. Recordable occupational injuries or illnesses

a. Fatalities, or

b. Cases involving lost workdays (days lost after day of injury or illness).

c. Cases without lost workdays which

(1) result in transfer of another job or termination,

(2) require medical treatment (other than first aid), or

(3) involve loss of consciousness or restriction of work or motion.

2. Establishment

a. Single physical location where operations are conducted, or

b. Places where people are paid or base from which personnel operate to carry out the activities for those who do not primarily report or work at a single establishment.

D. BLS statistical program

1. Systematic sampling survey done annually. About 280,000 firms take part in survey to calculate job injury and illness rates.

2. Data are published in "Accident Facts" by National Safety Council.

3. Statistical data published

a. Incident rates per 100 full-time employees for

(1) total recordable cases,

(2) total lost workday cases,

(3) cases involving days away from work and deaths,

(4) nonfatal cases without lost workdays,

(5) total lost workdays, and

(6) days away from work.

b. Formula for calculation of incident rates:

$$\text{Incident Rate} = \frac{\text{No. of injuries \& illnesses} \times 200{,}000 \text{ or No. of lost workdays} \times 200{,}000}{\text{Total hours worked by all employees during covered period}}$$

NOTE: 200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

E. Comments

1. Some OCS employers have participated in BLS statistical program and reported data for their establishments.

2. Accident information is not required to be submitted except as part of statistical sampling program.

3. Data on man-hours worked are required only if establishment is included in BLS statistical program.

II. CASMAIN Data Base (U.S. Coast Guard Casualty Reporting Requirements - 33 CFR Part 146; 46 CFR Parts 4, 26, 35, 78, 97, 109, 167, 185, 196 and 197)

A. Applicability: Vessels, mobile offshore drilling units, barges, fixed offshore platforms, diving

B. Sources of data

1. Complete Form CG-2692, "Report of Marine Accident, Injury, or Death," for certain accidents.

2. Owner, operator, or person in charge is responsible for submitting written report within 10 days of the casualty.

C. Accidents covered under program

1. OCS facilities

a. Death,

b. Injury to five or more persons in a single accident,

c. Injury causing any person to be incapacitated for more than 72 hours,

d. Damage affecting the usefulness of primary lifesaving or firefighting equipment,

e. Damage to the facility in excess of $25,000 resulting from collision by a vessel, and

f. Damage to a floating OCS facility in excess of $25,000.

2. Other categories - see instructions for completion of Form CG-2692. All must report loss of life and injury causing incapacitation over 72 hours.

D. Comments

1. Coast Guard regulations for accident reporting apply to most activities conducted on the OCS.

2. To be reportable, an accident must result in incapacitation for 72 hours (3 days). Accidents are recordable under OSHA program for 1 lost work day or more.

III. Events File (MMS)

A. Applicability: All OCS lessees/operators

B. Sources of data: Data drawn from OCS accident reports

C. Accidents covered: all traumatic events, including oil spills, blowouts, fatalities, injuries (absence from work for 72 hours or more), fires, explosions, collisions, structural failures

D. Comments

1. Events File contains primarily Gulf of Mexico information -- geographic coverage is not complete.

2. Reporting requirements duplicate some of those of the USCG.

IV. Pollution Incident Reporting System (U.S Coast Guard)

A. Applicability: Collection and maintenance of discharge data, response data, cleanup data, penalty data

B. Sources of data: Spill reports, USCG Form No. 4890

C. Accidents covered: All reportable spills

D. Comments:

1. Complete spill data base; however, spills from OCS facilities cannot be screened from all other spills without manual checking.

2. Data base is not OCS-specific. Can be queried on basis of geographic area (e.g., Gulf of Mexico) or latitude/longitude.

V. "Charlie Reports" (International Association of Drilling Contractors--IADC)

A. Applicability: Annual summary report of drilling injuries and deaths, designed for comparative studies by drilling contractors

B. Sources of data: Voluntary reports of member companies; includes reports on about 93 percent of drilling rigs and 95 percent of the offshore work force

C. Accidents covered: Fatalities and injuries resulting in inability of injured worker to return to work within 12 hours (one shift)

D. Comments:

1. Adjustments must be made to compare IADC statistics to other statistics:

a. USCG and MMS data bases define lost-time injuries as 72 hours off the job. The IADC and the BLS define lost-time injury as failure to report for the next shift (12 hours in the case of the OCS).

b. The IADC data system is designed for use in analysis of the OCS drilling workplace, and is not consistent with widely used American National Standards Institute (ANSI) guidelines for safety data recordkeeping. Notably, safety data on maritime operations is usually based on a 24-hour day. IADC workers are reported at risk for 12 hours a day (man-hours worked are reported). The effect of this is that IADC accident rates appear twice as high as other maritime accident rates, because the exposure base is defined as half that of other maritime accident data bases.

2. IADC data distinguish between offshore and onshore, but do not distinguish OCS from other offshore areas.

VI. MMS Platform Inspection Information System

A. Applicability: Provides field inspectors with an analysis of a structure and past inspection history

B. Source of data: Field inspectors' reports

C. Coverage: The Platform Inspection Information System contains information gathered during inspections of oil and gas platforms. There is information about the platform, hours spent inspecting, violations, departures granted, safety device settings and pipelines, well bay operations, production vessels, header systems, fired vessels, and possible items of noncompliance. A subset of the system, the complex/structure list, contains platform data including identifying information, distance from shore, water depth, structure detail such as number of drilling slots, year installed, and year removed.

D. Comments:

1. Provides current information on deficiencies, which can be used to identify not only the activities that pose the most consistent problems, but also the companies and locations.

2. These data provide MMS management with a way to monitor the activity of its field inspection offices.

3. Exposure data in the form of platform years can be obtained from the complex/structure list.

4. Includes Gulf of Mexico complexes/structures only. However, similar data are available in the other regions.

VII. MMS Borehole and Completion File

A. Applicability: Provides a complete engineering data file on each borehole

B. Sources of data: Forms DI9-330, "Well Completion Report," and DI 9-331, "Sundry Notice"

C. Coverage: Contains borehole and completion information about each well. Some of the data elements are field name, lease number, well name, and operator. For each borehole, there are total depth, date total depth reached, and elevation. For each completion, there are date of completion, perforation interval, type of completion, top production horizon, and reservoir name.

D. Comments:

1. Includes Gulf of Mexico wells only. However, similar data are available in the other OCS regions.

2. Can provide exposure data, specifically wells completed per year.

3. A separate file, the well history production file, contains individual well production data.

VIII. Lease Production and Revenue File

A. Applicability: Provides statistical documentation of revenue derived from individual leases both from lease sales and annual rentals and production

B. Sources of data: Lease sale and production records

C. Coverage: The base contains quantitative information regarding offerings by bidders for federal mineral leases and all production and revenue by year by individual lease

D. Comments:

1. These data are used by the U.S. Department of Energy, the U.S. Department of the Interior, the Federal Trade Commission, and nongovernment organizations and companies for various analyses.

2. The data are available to the public.

3. Source of production exposure data.

APPENDIX D

AN OUTER CONTINENTAL SHELF OPERATING COMPANY'S MANAGEMENT OF SAFETY

By John Wolfe
Conoco, Inc.

ORGANIZATION

The single most important element of safety at Conoco is that safety is a direct line responsibility of Conoco managers. The senior safety official is the vice president for North American Production Operations, who oversees all the activities of the operating divisions. The two subsidiary organizations under him with the largest roles in OCS safety are the Production Division, which controls offshore drilling and production operations, and the Human Resources Group, which has staff responsibility for the corporate safety program.

Below the vice president, the line responsibility for safety resides with operating divisions. The production manager, his production superintendents, and the operating personnel are primarily responsible. Subsidiary groups coordinate safety training, gather safety statistics, and help where possible, but the fundamental responsibility for the safety of operations is in the line production organization.

At our headquarters in Houston, an administration section controls personnel development. A corporate training group within this section houses a safety specialist. This safety specialist is a consultant to the division safety specialists, who in turn are consultants to the production superintendents and the line organization in the field.

The offshore operations manager in Houston has under his supervision the division managers in New Orleans, Lake Charles, and Lafayette, Louisiana. These divisions are slightly different in their makeup but have very similar operational organizations. The safety specialist in a small division such as Lafayette may have some training duties outside the safety area as well.

The Corporate Safety Division may make safety inspections of offshore facilities from time to time or may, upon request, supply information or make presentations at monthly safety meetings. In some cases corporate personnel supply safety information and training materials to the operating divisions.

TRAINING

Training is a very important element of the division's safety program. It is difficult to separate safety aspects from operational aspects. If you are adequately trained to operate the equipment on the platforms through apprenticeships and special schools to the point of really understanding your equipment and job, the safety of the equipment and of the personnel involved goes hand in hand. New equipment added to an offshore platform must go through a commissioning function, in which training sessions are held for involved personnel. Manufacturers' representatives, and possibly equipment specialists from the corporate production engineering services group, and other outside personnel may participate in this commissioning and testing.

The safety of employees begins on the first work day before they go offshore, as these employees are required to view safety slide presentations on offshore safety and helicopter safety before embarking offshore. The new worker is also provided with various safety manuals.

In his first year of employment, usually the earlier the better, each offshore employee will attend an aquatic survival course, which is an 8-hour in-the-water course taught by survival experts. This equips the employee for survival in Gulf waters should this be necessary. The new employee is also required to take first-aid training, including cardiopulmonary resuscitation. This first-aid course is repeated on an annual basis for all personnel who might be directly involved in this activity. Most corporate courses of this nature are repeated on 3-year cycles.

Conoco also operates its own fire-fighting training courses, which provide hands-on emergency response training. Each person on an offshore platform attends these courses as designated by the various divisions on the 3-year repeat cycle.

All company personnel who are assigned company automobiles or who are expected to drive such automobiles are required to attend a defensive driving course on a 3-year basis. Attendance at these defensive driving courses are open to all employees and their families.

Any offshore worker in a position to operate an offshore crane must be certified. An 8-hour class is required for certification. Subsequently, crane operators' performance is observed in the field.

The Minerals Management Service (MMS) requires some offshore workers to receive well control training. This training is normally obtained by Conoco workers at company schools. Some use is made of available outside schools.

There are a number of PETEX courses, (the Petroleum Extension Service of the University of Texas), and several American Petroleum Institute (API) safety programs available for special training. Selected individuals with safety responsibilities are sent to these schools on a continuing basis.

Encounters with hydrogen sulfide are a major offshore hazard, though not in the Gulf of Mexico. Conoco has an extensive hydrogen sulfide manual and has qualified personnel to give instructions on this equipment should it be required.

PROCESS DESIGN

Who is responsible for the process system and its design prior to installation on the platform? First of all, safety is one of the factors considered in the selection of process systems. The design engineers, whether they be in the local division office, the Houston engineering services group, or from an outside organization, all are aware of the desire for safety in Conoco's operation. Where possible, we avoid fired vessels; this means that waste heat from compressors or engine exhaust is used to supply any required heat. The offshore safety manual details a number of requirements to avoid having exposed fires on offshore platforms. Where these fires are required, extensive safety measures are taken to avoid any problems.

All of the facilities on Conoco's platforms are initially designed to API specification 14C, or more rigid criteria. API specification 14C was developed early in the 1970s to provide guidance for all operators in process system design. It has since been incorporated in OCS orders. Under API auspices, a committee was formed to supervise the 14 series documents relating to offshore safety and pollution. These include surface safety valves, subsurface safety valves, underwater safety valves, electrical systems, piping systems, and fire safety.

Minor projects and changes in existing field processes are normally made at the operating division level. The operating division may request help from the Production Engineering Services staff but are not by any means required to do so. They may also use consulting engineers or equipment personnel from suppliers to assist in the design. They normally make the safety analysis for these changes in the division office.

Major projects may require assistance from the Production Engineering Services staff and are sometimes farmed out to consulting firms for total engineering design. If this is done, some of Conoco's engineering personnel may be detailed to the contractor's office. Overall safety of the total package is included in this phase.

All monitoring and paper work to meet the MMS regulatory requirements are handled by operating division offices.

SAFETY MEETINGS

The basic management tool used to keep operating personnel sound in their attitudes toward safety is a monthly safety meeting. Topics for safety meetings are selected by local personnel to suit their operation. There are even some for home safety, such as defensive driving, safety in water sports, or hunting safety. It is very difficult to draw the dividing line between an operational relationship for the equipment and the safety relationship for the equipment. The most one can strive for is to integrate safe practices into the daily routine of operating personnel.

In addition to monthly safety meetings, most work sites have 5-minute safety discussions at the start of each work day. In these meetings, the proposed activities for the day are discussed and unusual safety aspects may be reviewed.

Where practical, quarterly meetings are held on a larger area basis so that experiences are more fully shared.

When unusual operations are to take place, such as welding operations requiring hot work permits or any other potentially hazardous operation, a safety meeting of 5 or 10 minutes is usually convened before beginning work. All safety aspects are discussed at that time.

In the regular monthly safety meetings, the staff or outside speaker may be the main event, but he does not govern the total activity of the meeting. Operating personnel may review any accidents that have occurred. Near-accidents also may be covered. Questions also may be raised about equipment or potentially hazardous situations. If these ideas are forthcoming and the hazards reported have not been corrected prior to the safety meeting, some individual will be delegated to handle the problem or some schedule adopted to review the safety question involved.

INSPECTIONS

Safety inspections are made of all platforms on a 6-month schedule. Teams are selected by the division manager, usually including representatives of the construction group, the safety and environmental section, the systems group, and an operation representative. Others may be incorporated for specific platforms as required.

At the completion of the inspection, report forms are filled out and submitted to the division manager. Any deficiencies noted on these forms must be corrected and a report filed to the manager when such correction has been completed.

Separate inspection teams measure vessel and pipe thicknesses on recurring schedules determined by platform sand production and other factors.

Routine safety inspections and tests are conducted as required by MMS. However, additional tests are made to insure that equipment is properly functioning at all times. At the beginning of each month a computer printout is developed of the tests required by well in a given area, during the following month. This is used by the operating personnel in the field to schedule their safety inspections on the various wells and equipment required for continued safety operation.

If MMS issues a safety alert that indicates a change in operations, the field usually discusses this at the next safety meeting, or may call a special meeting to discuss the safety alert when it is issued if it is a very urgent situation.

INDUSTRY ACTIVITIES

Conoco keeps its safety programs current through active participation in industry activities, including the activities of the API safety committee (and other committees such as that previously mentioned) which oversees the 14 series of engineering standards. Company personnel also participate in regional safety meetings with other industry personnel.

CONTRACTOR RELATIONSHIPS

How does Conoco assure that its contractors operate safely? Probably the most closely associated are drilling contractors. Conoco and many other offshore operators do not own drilling equipment, but contract instead for drilling services from various suppliers. Safety is one of the considerations in bid selection. In periods of slack activity, such as at present, Conoco can be a little more selective in its contractors. In addition to selecting contractors on the basis of safety as well as price, Conoco stresses to its contractors that safe operations lower insurance rates and, to a certain extent, direct costs.

Conoco controls very closely certain safety aspects of its offshore drilling contractors. These are usually specified in the detailed well plan. They include mud weights, pipe setting depths, blow out preventor equipment requirements (including tests), directional programs, provision for joint production and drilling activities, and many others. Conoco tries to use the safety expertise of its drilling contractors to supplement that of its own drilling personnel in all situations.

The second largest contract group in the field are labor contractors. In any given area, Conoco will generally settle on a few chosen contractors whose performance can be monitored closely. They are encouraged to have their own safety program. Some are not large enough to have their own strong safety program, so these contractors may be invited to attend Conoco safety meetings where standards of achievement are outlined. They may also be provided access to corporate manuals and training aids. Conoco maintains records on all labor contractors and closely monitors their accident records.

Other major contractors on drilling rigs include mud suppliers, cementing operations, logging and perforating companies, and downhole safety equipment specialists. In all these areas, Conoco buys service through contracts; included in that service is a required safety aspect.

REGULATIONS

In the implementation of new regulations, Conoco makes an analysis at headquarters of the effect on operations. Headquarters then makes recommendations to the operating divisions after discussing with them how the regulations might influence their operation. The following questions are asked: Are they going to require additional people? Is equipment adequate or is new equipment needed to comply with these regulations; or, Is additional money going to be required to update existing equipment?

After these questions have been adequately answered, the division managers, through the field operating organization, implement the new regulations. If it requires monitoring, it will be done by the safety specialist in the division with the advice and consultation of safety or maybe process personnel in the headquarters organization. Follow-up checks will be made by managers and their safety and regulatory specialists on a routine basis.

QUALITY ASSURANCE

What does a major company do about quality assurance on the multitude of products used offshore? The major products - the valves which control process flow and on which safety depends are tested in Conoco's research laboratory. Valves that fail will not be purchased. For some of the specialty items such as the subsurface safety valves which were mentioned before, Conoco relies on the American Petroleum Institute/American Society of Mechanical Engineers (API/ASME) program for testing. The company does only a limited amount of in-house testing due to the highly specialized nature of the product.

Field results of problems or successes are communicated to the worldwide Conoco organization through the operations group in Houston and through the Production Engineering Services group. The Production Engineering Services group receives monthly operation reports from each division and each international subsidiary. These are reviewed for successes and failures, and noteworthy reports are brought to the attention of other divisions where they might have application. The monthly operation report also includes a record of the safety and operational training that has taken place, and safety and environmental sections which spread the word on successes or problems with equipment and processes.

Of course, in all quality assurance activities, our surface and subsurface safety valves are designed and operated in accordance with the MMS regulations.

In analyzing the safety of our equipment, we find that over 96 percent of the failures involved are not equipment-related but are people-related.

ACCIDENT REPORTING

Despite Conoco's best efforts to avoid accidents, some do occur. How are accidents reported? First of all, is the accident job-related? If so, was any lost time or restricted duty required? Did the accident require medical treatment or first aid? If so, Occupational Safety and Health Administration (OSHA) requirements and the MMS requirements for accident reporting must be complied with. Any accident will be followed up by an investigation team. Where possible, one member of that team will be the person involved in the accident. Reports of accidents of this type will be circulated from the field organization through the division management organization, through the North American Production organization, and to the operational vice president in charge of North American Production. To my knowledge, Conoco is the only company where a report of this nature receives that kind of attention at the vice presidential level.

What about off-the-job accidents? If it is an accident that should be publicized further, it may be printed in newsletter form and circulated to all divisions. Off-the-job accidents may be included in safety meeting programs, and will be reported through channels as above, though usually not to the vice president.

In most of the offshore divisions, selected safety magazines are sent to the homes of employees for the use of the family in off the job safety. This is a part of continuing awareness which is the basis of the safety program in Conoco.

The automotive accident program relates only in a small manner to our offshore activity, but still, driving in New Orleans or any other major city has some aspects of safety involved in it. Auto accidents are classed as either preventable or nonpreventable and are reported through channels. Monthly reports are made on the total automotive fleet on a company-basis, and managers see who had accidents in what division last month.

Major accidents such as fires, deaths, or large oil spills are investigated by selected teams, usually from the division office. The reports of these various teams are circulated within the company, and to MMS or to OSHA as required. A major spill, fire, or death will be immediately reported to the headquarters office by telephone and will be followed by the investigative reports mentioned above. Any changes in policy, equipment, or operational programs recommended by these reports will be immediately implemented in the division where the incident occurred and may be expanded to the total production operation if the vice president so desires. Reports of major incidents are telephoned to headquarters for several reasons, not the least of which is that corporate vice presidents do not like to find out about that kind of accident from the evening news or in the local paper.

INCENTIVE AWARDS

In addition to the training programs, continuous management efforts, and preaching safety, Conoco has an incentive award program. Individuals receive awards for 5 years' accident-free work. Operating areas hold safety award dinners for each year without an accident. Normally, spouses are included at safety award dinners because they can influence the activities of their counterparts.

For automotive unit operators, there are 5-year safe driving awards for those assigned vehicles.

SUMMARY

In summary, how do you approach safety program management within a major company? First of all, you start at the top. But it cannot function without each employee doing his part. Conoco's philosophy is to provide a safe work environment, safe tools, and adequate training, and to instill safety attitudes in all employees. When this occurs, it is then up to the individual to maintain that safety attitude in all his activities.

APPENDIX E*

OUTER CONTINENTAL SHELF WORK PRACTICES

Outer continental shelf (OCS) oil and gas operations involve many of the practices common in the onshore oil and gas industry and also the maritime industry. Some OCS work practices place unusual conditions on workers. These include:

- o Commuting to and from work is time-consuming, frequently involves multiple forms of transportation, and may be risky.
- o The workplace isolates the workers from their family and/or usual social support systems.
- o Offshore work regularly employs workers on shifts longer than 8 hours.
- o Offshore work is scheduled around-the-clock. Thus, night work is required.
- o Offshore work regularly employs a work week of more than 5 consecutive workdays.
- o Shift starting times and workweek starting days are not standard or identical throughout the industry.
- o Relief for workers doing heavy physical work is unstructured and not mandatory.

Individually, many of the above conditions and practices are present in other industries. However, in combination, these conditions and practices yield a unique combination of work systems, equipment, and special environmental conditions.

*This background paper was compiled by the committee based on the findings of the study.

The 12-hour work day is common on the OCS and is coupled with 7 or more consecutive workdays. This contrasts with the use of the 12-hour workday in other industries, where it is usually part of a compressed work week whereby the 12-hour workday is limited to 3 or 4 consecutive days (Northrup et al., 1979; Northrup, 1951). The OCS work schedule has evolved, possibly as an adaptation to remote locations and management's desire to use two crews instead of three.

Where the 12-hour day for 7 or more consecutive days has been tried in other industrial settings (Sergean, 1971; Reynolds, 1941), it was abandoned due to increases in fatigue and discontent as well as reduction in output. A recent review of the literature predicts increases in performance error of 80 to 180 percent if around the clock operations are covered by two 12-hour shifts rather than three 8-hour shifts (Kelley and Schneider, 1983). This estimate may be conservative since it did not include the possible effects of a 7-day or longer work week. Other investigations provide additional evidence that fatigue levels and vigilance may be adversely affected by the 12-hour day (Swain and Guttman, 1980).

Furthermore, there is quantitative data that a number of special hazards can be associated with night work (Johnson et al., 1981), that the accident rate is affected by the time of day at which shifts start (Pokorny et al., 1981), that fixed rest breaks are superior to irregularly occurring breaks (Bhatia and Murrell, 1969), and that self-ratings by workers of their performance need not correlate with accident risk (Mackie and Miller, 1978).

The effect of OCS work practices on safety has not been fully evaluated. A special study would be necessary to discern the effect, if any, of various OCS work practices on the safety performance of OCS workers. Collecting data would be difficult, but is feasible. In addition to data on safety performance, information would be needed on shift duration, shift starting times, shift rotation rates, crew manning sizes, work break practices, days-off durations, and other related variables. In gathering data, care would have to be exercised to insure that the effect of one variable would not be masked or distorted by another variable.

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APPENDIX F*

POTENTIAL OF AUTOMATION TO IMPROVE OCS SAFETY INFORMATION MANAGEMENT

Once the Minerals Management Service (MMS) has a complete, organized, and automated outer continental shelf (OCS) safety information system, it will be possible for industry to transmit its own data, including computerized safety data, directly to the MMS. There are precedents for this. At present the Customs Service receives information from a steamship carrier by computer communications links (Container News, 1983). Such transfer benefits both government and industry. While it does not improve the system or make it work better, it does expedite and ease the data handling burden. Questions have been postulated as to whether computerized data links from offshore locations could be established with regulatory agencies to transmit and receive safety information.

The offshore oil industry has been as aggressive as other industries in using computers in its business and engineering activities. Since most of the management (decision-making) progress has been on shore, the computers have generally been located ashore.

An early computer production control (CPC) system fed information from offshore production controls and sensing units to a central computer, which in turn, fed control signals back to the production equipment. More recently, computer data collection (CDC) systems have been developed, sometimes with computer terminals located offshore to input the extensive data generated by a producing oil field.+ Such systems can be adapted to the collection of safety information, if the volume of information makes this desirable.

Some companies have developed computerized maintenance systems. Most of these involve shore-based computers which feed work instructions to offshore workers by computer printouts and receive information

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*This background paper was compiled by the committee based on the findings of the study.

+Floyd E. Garrot, Exxon Company, U.S.A., personal communication, September 1983.

on completed work via the same printouts as annotated by the workmen. These systems have an indirect effect on safety to the extent that they improve the quality and reliability of equipment maintenance.

The largest offshore operators have their own computerized safety information systems to store, handle, and manage safety information. However, the use of computers does not automatically provide the reliable transmission of data. Some form of telecommunications is needed to transmit information from point to point, whether computers are involved or not. Hardwire telephone lines are available offshore on some of the established production fields. Microwave links are used extensively where line-of-sight communications are possible. Various forms of radio transmissions have been used for voice communications. However, the establishment of highly reliable communications links to handle large quantities of information (such as is required for computers to communicate) have not been as common, due to the high costs and technical problems. Recently, however, communications between offshore platforms and shore locations have been established through satellites operated by the COMSAT (INMARSAT) system; and more recently via a specialized satellite system established by Geosource/SBS Communications, Inc. These have the capability of linking offshore computers to onshore computers (Ocean Industry, 1983). Undoubtedly, such computer-to-computer links will be established as they become cost effective. Some of the computer data collection systems already have the capability of transmitting offshore data to onshore units via offshore computer terminals. Such links, where available, could be used to transmit safety information.

From the foregoing it can be seen that computerized links between the government's safety information system and OCS installations and workplaces would be technically feasible, provided that the government established a well-organized and comprehensive data base, and developed the necessary analytical capabilities to make use of such a system. However, it should be recognized that, barring unforeseen development, the volume of safety information on individual platforms would not be sufficient to justify computerized telecommunications. It is also unlikely that corporate managers would sanction the direct transmission of information between offshore oil installations and the government without some supervisory control. Furthermore, it is far-fetched that regulatory agency analysts could produce safety analyses specific or detailed enough to assist individual offshore platforms in identifying specific accident causes in near-real-time, since highly detailed causal or forensic information about accidents is most often acquired after-the-fact from eyewitness accounts and as the result of special investigation.

Although the volume of safety information collected from individual platforms may not justify computerized telecommunications, another alternative is the use of low-cost microcomputer systems which use disks for program input and data output. Microcomputers are already used in a great many industrial settings, including offshore operations. Furthermore, the federal government has begun to take advantage of microcomputers for data acquisition (Ackland, 1983).

The government could provide OCS installations and workplaces with safety information program input disks, as well as safety information data output disks, to gather information for the government's safety information system ashore. The government-supplied software could be written for a number of microcomputer operating systems so that the safety information programs would be available for more than one manufacturer's system. The government safety information system would also be designed to handle input from safety information data output disks produced by these various systems. Safety information data output disks would be forwarded, after data entry, to the government by mail or other form of transmission; the use of telecommunications would be optional.

An on-site microcomputer system has five potential advantages. First, the system provides sophistication and flexibility at low cost. Second, the software could be designed to yield the same data as existing manual-entry safety information data forms. Thus, industry use of the computerized system would be optional. Third, the ability of corporate managers to preview and sanction the forwarding of specific safety information disks would not be precluded since direct telecommunications transmission would be optional given the use of the disk medium.

Fourth, adaptive ("tailored") form completion techniques could be incorporated in the software to determine which safety information forms/data are to be collected for the specific platform and/or safety incidence. This would insure that all appropriate information is requested, that inappropriate information is not requested, and the same information is not requested more than once. This is another way of approaching current duplication problems, and one which does not require any new agency to give up any form since software could be written to produce hard copy versions of current forms using disk-stored data. The feasibility of microcomputer data collection of this sort has already been demonstrated in the testing area (Vale, 1981).

Fifth, experience in many studies indicates that automated data collection techniques can be used to collect reliable data from unsophisticated and/or uncooperative operators (Johnson, 1981). User resistance to automated information collection can be minimized if human factor variables are considered in the design and introduction of the software system (Johnson, et al., 1981).

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