



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Log M-321

Date: October 14, 1986

In reply refer to: M-86-102 through -107

Admiral Paul A. Yost, Jr.
Commandant
U.S. Coast Guard
Washington, D.C. 20593

On October 27, 1985, the U.S. mobile offshore drilling unit PENROD 61 was drilling for oil at an offshore drilling site about 25 nautical miles (nmi) south of the Louisiana coast in the Gulf of Mexico. The PENROD 61, a self-elevating type drilling unit, was in the jacked-up mode in about 246 feet of water and was elevated about 50 feet above the surface of the water on three bottom bearing legs. About 2330 c.s.t. in seas reported to be in excess of 30 feet high and in winds gusting to 80 knots, the PENROD 61 collapsed into the sea. The 43 persons on board abandoned the vessel and all but one were later rescued. After it fell into the sea the PENROD 61 drifted with the wind and sea, struck the nearby PENROD 60, and subsequently sank about 9 nmi northwest of its drilling site. As a result of this accident the PENROD 61, valued at \$40 million, was destroyed and one man lost his life. 1/

Since the collapse of the PENROD 61 did not result from a failure of the leg jacking or braking system or from a "punch through," a catastrophic structural failure of the bow leg probably occurred. The PENROD 61's legs were designed to withstand wind and sea conditions more severe than those encountered at the time of the accident. The PENROD 60, which was identical in design, and slightly older than the PENROD 61, did not collapse, and it had been subjected to the same wind and sea conditions and to the significant additional forces which occurred when the drifting hull of the PENROD 61 struck it. The Safety Board, therefore, concludes that the wind and sea conditions alone did not cause the bow leg of the PENROD 61 to fail. The bow leg of the PENROD 61 could have been weakened sufficiently by corrosion, metal fatigue, previous structural damage, or construction defects to cause a structural failure of the bow leg. However, due to the prohibitive cost of such an operation, appropriate samples of the broken bow leg were not recovered for metallurgical analysis, and the Safety Board, therefore, is unable to determine the cause or precise manner of the failure of the bow leg.

1/ For more detailed information read, Marine Accident Report—"Collapse of the U.S. Mobile Offshore Drilling Unit PENROD 61, Gulf of Mexico, October 27, 1985 (NTSB/MAR-86/10).

If a defect existed in the bow leg structure in the area where the leg broke, it would not have been detected at the time of the Coast Guard inspection because the entire length of the leg was not thoroughly examined. The Coast Guard has no requirement that the entire length of the legs of self-elevating MODUs be thoroughly examined and there are no inspection procedures that would provide guidance to an inspector in conducting such an examination. Additionally, the offshore drilling industry has no known self-imposed inspection standard for conducting periodic examinations of self-elevating MODU legs over their entire length. Since these legs support the MODU in the elevated mode, their material condition is critical to safe MODU operations. Because MODUs are elevated to various heights depending upon the depth of water in which they are working, different portions of the legs are placed under load at different times. Additionally, these legs are subjected to the deteriorating effects of a marine environment and to physical damage from vessels that service the MODUs. A recent paper ^{2/} submitted to the International Maritime Organization's Maritime Safety Committee by the Government of Norway stated that from January 1, 1970 through December 31, 1984 there have been a total of 166 "significant" structural failures on board MODUs of all nationalities and that 45 of these failures occurred on board U.S. MODUs. Although it did not identify the nature of the structural failures, this report showed that structural failure was the major type of accident that MODUs suffered during this time and is indicative of the need for improved inspection procedures on MODUs. A defect can develop anywhere along the length of a leg, and if the entire length of the leg is not thoroughly inspected, it may not be detected before it causes a catastrophic failure. The Safety Board believes that the Coast Guard should require the thorough inspection of the entire length of self-elevating MODU legs at the time of their periodic drydock examination (or special examination in lieu of drydocking). Additionally, the Safety Board believes that the Coast Guard should develop an inspection procedure to provide guidance to their inspectors on the methods and criteria to be used in conducting such inspections.

The GILBERT C had been contracted by Chevron to provide standby vessel services to the PENROD 60 and PENROD 61. The master maintained his vessel moored to an anchor buoy between the two MODUs until about 1630 on October 27, 1985. Throughout the day, the wind and sea conditions continued to deteriorate and when seas began breaking over his vessel's bow, the master became concerned for the safety of his vessel and crew. The Safety Board recognizes that, although the GILBERT C was placed on station to provide assistance to the MODUs, the master's primary responsibility was to the safety of his own vessel and crew. The Safety Board believes that the conditions were severe enough to pose a threat to this 100-foot vessel, and believes that the master was justified in his concern for the safety of his vessel and crew.

Despite his concern for the safety of his vessel, the master of the GILBERT C remained on station as long as possible and maintained radio contact with the PENROD 61. He asked about their evacuation plans and offered to take personnel off the MODU. Since his offer to take personnel off the MODU was refused, he requested and was granted permission to leave the area to seek a harbor of safe refuge from the storm.

The GILBERT C was a conventional passenger carrying crewboat which was designed to take personnel to and from offshore installations. It was not specifically designed to serve as a standby vessel for MODUs in severe weather, and did not have sufficient capacity to evacuate all of the personnel on either rig. Neither was the GILBERT C outfitted with any specialized gear suitable for the retrieval of persons from the water,

^{2/} Norwegian Maritime Directorate, "Mobile Offshore Drilling Units (MODUs)," May 26, 1986.

nor was the vessel's crew thoroughly trained in water rescue procedures. In addition, the master of the GILBERT C testified that he did not believe that he could have rescued anyone from the water in the sea conditions that prevailed on October 27. He said that, if requested to do so, he would have attempted to receive personnel on board his vessel from the deck of the MODU. However, he further testified that, in order to do this, the stern of his vessel, which had only 4-feet of freeboard, would have been completely submerged by the 20-foot seas and people could have been washed overboard. Additionally, the master of the GILBERT C stated that had he been in the area when the capsules were launched he would not have attempted to rescue survivors from the capsules because the capsules might have been smashed against the side of his vessel in the high seas. The Safety Board believes that, had the GILBERT C remained on station until the PENROD 61 collapsed, it is doubtful that its presence would have materially altered the outcome of this accident. However, if a vessel of sufficient size and greater seakeeping ability suitably equipped with rescue equipment and with a crew that had been thoroughly trained in water rescue procedures in adverse sea conditions had been assigned to standby duty, it might have been able to rescue all of the persons who were in the water after the No. 2 survival capsule capsized.

The Safety Board believes that there is a need for standby vessels to be stationed near MODUs that are working offshore, that these vessels should be capable of remaining on station in adverse weather and sea conditions, that they should be outfitted with state-of-the-art water rescue equipment, and that their crews should be thoroughly trained in water rescue techniques. The Safety Board has addressed this issue in previous MODU accidents. In 1982, the U.S. MODU OCEAN RANGER ^{3/} capsized and sank in adverse sea conditions resulting in the loss of 84 lives. Some of the crewmen from the OCEAN RANGER escaped from the MODU in a lifeboat, but when the standby vessel approached the lifeboat, the lifeboat capsized throwing the survivors into the sea. The crew of the standby vessel was unable to recover a single person from the sea because the vessel was not outfitted with equipment capable of retrieving incapacitated persons from the water. As a result of its investigation of this accident, the Safety Board recommended that the U.S. Coast Guard:

M-83-20

Require that a suitable vessel, capable of retrieving persons from the water under adverse weather conditions, be assigned to all U.S. mobile offshore drilling units at all times for the purpose of evacuating personnel from the unit in an emergency.

The Coast Guard partially concurred with this recommendation. However, rather than requiring standby vessels to be in attendance at all times for MODUs, the Coast Guard stated that offshore supply vessels which "routinely operate in the vicinity of mobile offshore drilling units" would provide adequate standby vessel support to MODUs if the offshore supply vessels were required to carry rescue boats capable of taking an unconscious person on board from the sea. The Coast Guard expects to issue a notice of proposed rulemaking by the end of 1986 which includes a requirement for rescue boats on offshore supply vessels. The Safety Board recognizes the need for rescue boats to be

^{3/} Marine Accident Report--"Capsizing and Sinking of the U.S. Mobile Offshore Drilling Unit OCEAN RANGER off the East Coast of Canada, 166 Nautical Miles East of St. John's, Newfoundland, February 15, 1982" (NTSB/MAR-83/2).

carried on offshore supply vessels, but also recognizes that the proposed regulatory action provides a lesser degree of support to MODUs working offshore than that envisioned by recommendation M-83-20. In reply to the Coast Guard's response to this recommendation, the Board pointed out that without a specific requirement it seems unlikely that offshore supply vessels would be in the vicinity of operating MODUs at all times. Additionally, the Board stated that it seems unlikely that an offshore supply vessel would be scheduled to replenish a MODU at a time when a severe storm is forecast. The Board reminded the Coast Guard that other nations (e.g. Canada, United Kingdom, and Norway) require standby vessels for MODUs operating within their jurisdiction.

As a result of its investigation of the capsizing and sinking of the U.S. drillship GLOMAR JAVA SEA ^{4/} which resulted in the loss of 81 lives, the Safety Board reiterated recommendation M-83-20. In response to this reiteration, the Coast Guard Commandant stated:

We have given further consideration to NTSB recommendation M-83-020 which recommends that the Coast Guard require a suitable vessel, capable of retrieving persons from the water under adverse weather conditions, be assigned to all U.S. MODUs at all times for the purpose of evacuating personnel from the unit in an emergency. As a result, we published an advance notice of proposed rulemaking . . . in the "Federal Register" on March 7, 1985, (50 FR9290) soliciting comments regarding the use of standby vessels in an overall evacuation plan for MODUs and fixed platforms and lifesaving equipment requirements for fixed facilities.

Legislation ^{5/} is pending in Congress that would require a standby vessel capable of rendering immediate assistance in the immediate vicinity of all manned installations (including MODUs) on the outer continental shelf of the United States. On November 12, 1985, a Coast Guard representative presented a statement of the Coast Guard's position on this proposed legislation before the House of Representatives Merchant Marine and Fisheries Committee's Subcommittee on the Panama Canal and the Outer Continental Shelf.

The Safety Board believes that the Coast Guard's stated position on the need for standby vessels in attendance at MODUs is ambiguous. On the one hand, the Coast Guard admits that properly designed, equipped, and manned standby vessels in the immediate vicinity of MODUs would increase the safety of offshore workers on the outer continental shelf; while on the other hand, the Coast Guard states that a MODU should be "self-sustaining and capable of providing its own means of abandonment in the event of an emergency." While the Safety Board agrees that MODUs should be capable of providing their own means of abandonment, accident investigations have shown that primary lifesaving devices and their launching equipment are subject to damage or destruction in an emergency and have not been available for use when needed. The OCEAN RANGER, the OCEAN EXPRESS, the GLOMAR JAVA SEA, and the PENROD 61 were all capable of providing for their own abandonment, but in each of these accidents primary lifesaving

^{4/} Marine Accident Report--"Capsizing and Sinking of the United States Drillship GLOMAR JAVA SEA In the South China Sea, 65 Nautical Miles South-Southwest of Hainan Island, People's Republic of China, October 25, 1983" (NTSB/MAR-84/08).

^{5/} H.R. 1748, Offshore Installation Emergency Evacuation Act.

equipment was either damaged or failed in one manner or another. These accidents vividly demonstrate the need for standby vessels. More than 4 years have passed since the OCEAN RANGER accident occurred, and lives continue to be lost in MODU accidents because there is no requirement that MODUs be attended by suitable standby vessels which are capable of withstanding adverse weather and sea conditions, properly equipped with state-of-the-art water rescue equipment, and manned by suitably trained crewmen. The collapse of the PENROD 61 demonstrates once again that there is a need for such a requirement. The Board has placed Safety Recommendation M-83-20 in an "Open--Unacceptable Action" status.

The Coast Guard's statement also points out the fact that a major cause of MODU abandonment has been severe weather and that, unless standby vessels are designed to withstand severe weather conditions, requiring them to remain on scene could place the vessels and their crews in jeopardy. The Safety Board wholeheartedly agrees with this portion of the statement. Recommendation M-83-020 recommends that the Coast Guard require that only a "suitable vessel" be assigned to a MODU to act as a standby vessel. The Board would not consider a vessel to be "suitable" unless it was designed to withstand severe weather conditions.

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As an alternative to mandatory standby vessels, the Coast Guard statement proposed the establishment of "an evacuation performance standard" and a requirement for a "site-specific emergency evacuation contingency plan" which may or may not include the use of standby vessels. Although the Safety Board is not opposed to an "evacuation performance standard" or to a "site-specific" evacuation plan per se, we cannot visualize a situation where a standard or a plan should not include a requirement for a properly designed, equipped, and manned standby vessel.

The survival capsules on board the PENROD 61 were of adequate capacity to accommodate all of the persons on board. With the exception of the welder who abandoned the MODU in an inflatable liferaft and the third party service hand who jumped overboard, all persons on board the PENROD 61 escaped in capsules before the MODU sank. The launching system operated properly and the capsules were lowered to the sea and released successfully. However, the heaving and rolling of the capsules caused most of the men inside to become seasick and fatigued very soon after the launching. Nevertheless, the capsules operated for some time without mishap and kept the survivors dry and protected from the elements. The capsules appeared to be performing adequately until the No. 2 capsule capsized suddenly approximately three hours after it was launched. Model tests of the 9091 Whittaker survival capsule showed that the capsule would remain upright when subjected to a 24-foot-high regular wave, and would capsize in steep, breaking waves 45- to 48-feet high. However, the tests did not take into account the affects of high winds and no tests were performed with waves heights between 24 feet and 45 feet so that the minimum wave height that would cause the capsule to capsize was not determined. The reconstructed weather conditions for the vicinity of the PENROD 61 close to the time of the rig's collapse showed that the maximum wave height was above 24 feet. Since ocean waves travel at different speeds, faster waves overtake slower

waves and combine to form a resultant wave that can be appreciably larger than either of the individual waves. It is, therefore, possible that the No. 2 capsule encountered a wave appreciably greater than 24 feet in height which caused the capsule to capsize. In the OCEAN EXPRESS accident, two Whittaker model 9091 survival capsules capsized resulting in the loss of 13 lives. As a result of its investigation of this accident, the Safety Board recommended that the Coast Guard:

M-79-45

Develop appropriate survival capsule performance standards, including standards for safe towing.

M-79-46

Conduct model tests and computer simulations with Whittaker Corporation to determine the survival capsule's capsizing characteristics and behavior in storm seas.

The Coast Guard concurred with these recommendations. In response to these recommendations the Coast Guard Commandant stated,

We will not limit consideration to survival capsules alone. A more complete understanding of the rough water characteristics of all types of totally enclosed lifeboats and liferafts is required. Research and development programs for three studies (enclosed lifeboats, rescue boats, and inflatable liferafts) have been developed. A period of background study and limited testing will identify designs and concepts for more complete testing. Test items will then be acquired for both model tests under controlled conditions, and full scale tests at sea. The tests will be followed by an evaluation period, and if necessary, another round of tests will be scheduled to evaluate proposed modifications. The program will include studies of towing, capsizing and self-righting characteristics, and rough water performance. The Coast Guard, representing the United States at the Inter-Governmental Maritime Consultative Organization in the revision of Chapter III, "Lifesaving Appliances," of the Safety of Life at Sea Convention, has supported the introduction of a requirement that all totally enclosed survival craft be self-righting when all hatches are closed, all persons are secured in their seats with seat belts, and there is no water inside. The United States has also introduced a requirement that all such craft be arranged to allow an above-water escape during any possible condition of flooding or equilibrium. The enclosed lifeboat research and development program is funded for FY 1980, and the contract for the first phase of the program has been awarded. The full program is expected to take five years with completion projected for 1984.

Despite the Coast Guard's response to these recommendations, the proposed research and development program was never completed and no model tests or computer simulations of the Whittaker survival capsule were ever conducted by the Coast Guard.

Although the SOLAS convention does not specifically apply to non-self-propelled MODUs such as the PENROD 61, initial indications from the Coast Guard are that the new SOLAS performance standards for covered lifeboats will be applied to U.S. MODUs in

the notice of proposed rulemaking currently under development. The Safety Board supports the Coast Guard's intention to apply these new standards to covered lifeboats on MODUs, and believes that the safety of MODU crewmen will be significantly improved by these new standards. The Safety Board will hold Safety Recommendation M-79-45 in an "Open—Acceptable Action" status pending publication of a final rule incorporating these proposed changes. It is anticipated, however, that the new standards will apply only to lifeboats installed on new MODUs constructed after the effective date of the proposed regulations. In that case existing MODUs, therefore, will continue to carry lifeboats that do not meet the new standards, as long as the appliances are maintained in good and serviceable condition. The Safety Board is opposed to granting open-ended grandfather rights for primary lifesaving equipment. The Board believes that existing substandard lifesaving equipment should be phased out of service within a specific time period, such as five years. To continue to use outmoded primary lifesaving equipment on existing vessels in the face of required improvements on new vessels creates two standards of safety. MODU crewmen working on existing MODUs will face the same risks as those employed on new MODUs, but will be afforded a lower standard of safety.

The hurricane contingency plan developed by Chevron which was in effect at the time of this accident did not provide clear, step-by-step instructions for the evacuation of personnel from MODUs working offshore and Penrod had no formal hurricane evacuation plan at all.

No Federal guidelines currently exist to provide the offshore oil exploration and exploitation industry with hurricane evacuation planning assistance. However, the U.S. Coast Guard, under the authority of the Outer Continental Shelf Lands Act Amendments of 1978 (Public Law 95-372), has primary responsibility for the protection of life and property on the outer continental shelf of the United States. Since any potentially hazardous weather conditions may place the lives of offshore workers in jeopardy, the Safety Board believes that the Coast Guard should take action to provide technical assistance and coordination support to the offshore oil industry in the development of joint hurricane evacuation plans. In addition to increasing the safety of offshore workers, such action would also benefit the Coast Guard. The timely evacuation of offshore facilities would reduce the amount of Coast Guard search and rescue resources needed during periods of hazardous weather.

As a result of its investigation of the collapse of the PENROD 61, the National Transportation Safety Board reiterates Safety Recommendation M-83-20 and recommends that the U.S. Coast Guard:

Amend 46 CFR 107 to require the thorough inspection of the entire length of self-elevating MODU legs at the time of regular drydock examination or special examination in lieu of drydocking. (Class II, Priority Action) (M-86-102)

Develop an inspection procedure which will provide guidance to Coast Guard marine inspectors in conducting inspections of the entire length of self-elevating MODU legs. (Class II, Priority Action) (M-86-103)

Develop seakeeping, equipment, and manning standards for standby vessels in attendance of mobile offshore drilling units. (Class II, Priority Action) (M-86-104)

In conjunction with the regulatory project to incorporate new Safety of Life at Sea Convention covered lifeboat standards into the U.S. Code of Federal Regulations, include a requirement that existing covered lifeboats that do not meet the new standards shall be phased out of service onboard mobile offshore drilling units within a reasonably short period of time. (Class II, Priority Action) (M-86-105)

Require that U.S. MODUs operating in the Gulf of Mexico have detailed severe weather evacuation plans which set forth the order in which personnel will be evacuated, identify the transportation resources to be used in the evacuation, and include time and distance factors for the initiation of evacuation before the onslaught of hazardous weather conditions at the location of the MODU. (Class II, Priority Action) (M-86-106)

Publish guidelines and provide technical assistance to aid MODU owners and operators in the Gulf of Mexico to develop effective severe weather evacuation plans. (Class II, Priority Action) (M-86-107)

Also, as a result of its investigation, the Safety Board issued Safety Recommendations M-86-108 to the International Association of Drilling Contractors and M-86-109 through -112 to the PENROD Drilling Company .

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members concurred in these recommendations.

By: 
Chairman