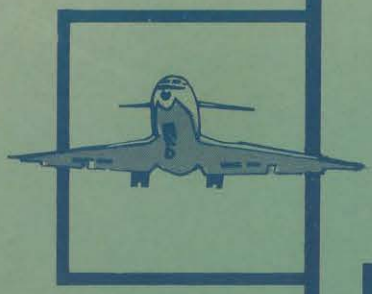
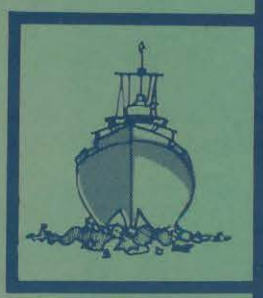




NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

CAPSIZING AND SINKING OF THE
SELF-ELEVATING MOBILE OFFSHORE
DRILLING UNIT OCEAN EXPRESS
NEAR PORT O'CONNOR, TEXAS
APRIL 15, 1976

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB-MAR-79-5	2.Government Accession No.	3.Recipient's Catalog No.
4. Title and Subtitle Marine Accident Report - Capsizing and Sinking of the Self-elevating Mobile Offshore Drilling Unit OCEAN EXPRESS near Port O'Connor, Texas, April 15, 1976		5.Report Date April 5, 1979 6.Performing Organization Code
7. Author(s)		8.Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10.Work Unit No. 2362-A 11.Contract or Grant No. 13.Type of Report and Period Covered
12.Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		Marine Accident Report April 15, 1976 14.Sponsoring Agency Code
15.Supplementary Notes		

16.Abstract About 1100 c.s.t. on April 14, 1976, the self-elevating drilling unit OCEAN EXPRESS departed a drilling site in the Gulf of Mexico under tow for a new drilling site about 33 nmi away. The OCEAN EXPRESS arrived at the new drilling site about 2330, but was not set in place because of adverse seas. Three tugs held the OCEAN EXPRESS in position awaiting better weather, but the seas continued to increase. On April 15, one tug's starboard reduction gear failed, and another tug's towline broke. With only one effective tug remaining, the OCEAN EXPRESS turned broadside to the wind and seas, drifted, grounded, capsized, and sank about 2115. Thirteen persons drowned in a capsized survival capsule.

The National Transportation Safety Board determines that the probable cause of the accident was the complete loss of control of the OCEAN EXPRESS because of equipment failures on two of the three assisting tugs, which allowed the unit to turn broadside to the wind and seas, drift, ground, and capsize. Contributing to the accident were the lack of preparation for towing emergencies, the lack of complete information in the unit's operating manual, and the inaccuracy of the National Weather Service's weather forecasts.

Contributing to the loss of life was the capsizing of the No. 3 survival capsule because of extreme wave action alone or in combination with tripping forces imparted by a small line attached to the rescue tug.

17.Key Words	18.Distribution Statement
Self-elevating mobile offshore drilling unit; survival capsule; weather forecasts; towing; operating manual; Gulf of Mexico; industrial personnel; training; jacking limits; contingency plans; grounding; sea; swell; directional control; extreme wave action.	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

19.Security Classification (of this report)	20.Security Classification (of this page)	21.No. of Pages	22.Price
UNCLASSIFIED	UNCLASSIFIED	34	

NTSB Form 1765.2 (Rev. 9/74)

CONTENTS

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

Adopted: April 5, 1979

CAPSIZING AND SINKING OF THE SELF-ELEVATING MOBILE OFFSHORE DRILLING UNIT OCEAN EXPRESS NEAR PORT O'CONNOR, TEXAS APRIL 15, 1976

SYNOPSIS

About 1100 c.s.t. on April 14, 1976, the self-elevating mobile offshore drilling unit OCEAN EXPRESS departed a drilling site near the Texas coast in the Gulf of Mexico under tow for a new drilling site about 33 nmi northeast. The OCEAN EXPRESS arrived at the new site about 2330, but was not set in place because of adverse seas. Three tugs held the OCEAN EXPRESS in position awaiting better weather, but the seas continued to increase. About 1530 on April 15, one tug became partially disabled because of a reduction gear failure. At 1930, another tug's towline broke. With only one effective tug remaining, the OCEAN EXPRESS turned broadside to the wind and seas, drifted, grounded, capsized, and sank about 2115. The vessel was valued at $20 million.

The bargemover was rescued by a Coast Guard helicopter. The crew abandoned the OCEAN EXPRESS in the unit's survival capsules. The 14 persons in one capsule were rescued without incident. The other capsule capsized with 20 persons inside; 7 persons escaped and 13 persons drowned.

The National Transportation Safety Board determines that the probable cause of the accident was the complete loss of control of the OCEAN EXPRESS because of equipment failures on two of the three assisting tugs, which allowed the unit to turn broadside to the wind and seas, drift, ground, and capsize. Contributing to the accident were the lack of preparation for towing emergencies, the lack of complete information in the unit's operating manual, and the inaccuracy of the National Weather Service's weather forecasts.

Contributing to the loss of life was the capsizing of the No. 3 survival capsule because of extreme wave action alone or in combination with tripping forces imparted by a small line attached to the rescue tug.

INVESTIGATION

The Accident

At 0900 [1] on April 13, 1976, the Ocean Drilling and Exploration Company (ODECO) bargemover boarded the self-elevating mobile offshore drilling unit OCEAN EXPRESS to direct preparations for moving the unit from block 803 to block A57 [2] in the Gulf of Mexico. The bargemover estimated that it would take 12 hours to make the 33-nmi trip. Three Gulf-Mississippi Marine Corporation tugs, GULF VIKING, GULF EXPLORER, and GULF KNIGHT, which had been assigned to move the OCEAN EXPRESS, arrived about 1200.

At 0700 on April 14, the bargemover started lowering the OCEAN EXPRESS' platform. By 0800 the platform had been jacked down to the ocean surface, and by 1000 the mat was being raised to a draft of 80 ft. The bargemover chose this draft to insure sufficient bottom clearance in moving from a water depth of 124 ft at block 803 to a water depth of 199 ft at block A57. The tugs were shifted from the holding arrangement to the towing arrangement, and the unit was underway by 1100.

While underway the OCEAN EXPRESS developed a port list, and compensating salt water ballast was taken on board. The cross-connection valves between the fuel oil tanks and the drill water tanks had been left open, allowing the liquids in the tanks to flow to port. The aft, port void tanks in the platform were checked for leaks; none were found.

A few hours before the unit arrived at the new drilling site, the bargemover started lowering the mat in preparation for placement on the bottom. The compensating ballast was pumped overboard. At 2330, the OCEAN EXPRESS arrived at the new location, and two tugs were shifted from the bow towing position to the stern mooring bitts so that the unit could be positioned accurately over the new drilling site.

At 0100 on April 15, the ODECO toolpusher and the Marathon Oil Company drilling superintendent decided that the seas were too rough to continue jacking. They discussed this with the bargemover, who agreed, and jacking was stopped with the mat positioned at a 148-ft draft. Anticipating calmer seas, the bargemover ordered the tugs to hold the unit in position.

1/ All times herein are central standard based on a 24-hour clock.
2/ Block refers to an offshore oil drilling lease area. Blocks 803 and A57 are in the Mustang Island Area about 30 miles offshore between Corpus Christi and Port O'Connor, Texas.

By 0730, wave action was forcing water up inside the columns and through the jacking pin holes into the jacking houses. At 1000, the increasing seas forced the bargemover to order the tugs to turn the OCEAN EXPRESS' bow into the seas. At this time, the GULF VIKING was still attached to the port bow, the GULF KNIGHT to the port stern, and the GULF EXPLORER to the starboard stern. At 1200, the GULF VIKING's towline was lengthened to compensate for the increasing seas.

The GULF KNIGHT's starboard reduction gear failed at 1510. The bargemover offered to release the GULF KNIGHT, but her captain chose to stay until a relief tug arrived, even though he could not continue holding the OCEAN EXPRESS.

Throughout the afternoon, the OCEAN EXPRESS' crew tightened hatch covers and ventilation closures to stop small leaks and pumped out the water that accumulated in the quarters and storerooms. Deck cargo lashings were checked and tightened. Leaks in the galley ventilator could not be stopped, and water in the galley drained into the lower quarters with accumulations of 2 to 6 in. Water continued to come through the jacking pin holes in the columns, but the pumps were able to remove it.

By early evening the OCEAN EXPRESS was rolling about 6° and pitching about 8°. Waves were continually washing across the main deck, but the two functioning tugs satisfactorily held the OCEAN EXPRESS into the seas and in position. Position checks were made by the tugs and the survey vessel NICOLE MARTIN.

Although it was in good condition and properly sized, the GULF VIKING's towline broke about 1930. The one remaining stern tug, GULF EXPLORER, could not hold the OCEAN EXPRESS' bow into the seas. The OCEAN EXPRESS turned her port side toward the waves and began drifting northwest toward shore. The tug captains and the bargemover discussed transferring the GULF EXPLORER to the bow towing position; the tug captains thought it could be done, but the bargemover did not want to disconnect the one remaining tug and leave the OCEAN EXPRESS completely adrift. After the towline was repaired by the tug's crew, the GULF VIKING was ordered to stand by the port bow. The bargemover and the GULF VIKING's captain did not discuss how they would reconnect the towline, and the OCEAN EXPRESS did not answer the GULF VIKING's radio calls promptly.

The OCEAN EXPRESS' crew attempted to retrieve the broken towline to rig a new line to it, but they were forced back by boarding seas. There were no bitts or padeyes on the upper deck of the OCEAN EXPRESS where a towline could be attached, so the crew tried to secure a line around a crane foundation but were again unsuccessful.

Between 1930 and 2000, the boarding seas shifted the heavy deck cargo of drill pipe, drill collars, and well casing. Some of the cargo broke loose and threatened to damage the ventilators aft of the superstructure, which would have allowed the machinery room and lower deck in the platform to flood. The cargo was stored in racks and had been secured adequately for seas within the OCEAN EXPRESS' normal operating limits.

About 1945, an ODECO driller sounded the general alarm. Sleeping crewmembers awoke, and everyone assembled on the upper deck, clothed and wearing lifejackets.

At 2000, the drilling superintendent radioed his home office and requested that the Coast Guard be called to remove the Marathon employees from the OCEAN EXPRESS. The Coast Guard station at Corpus Christi received Marathon's call at 2010, and the first helicopter was airborne at 2018.

The bargemover called ODECO's main office at 2030 to report the situation and request advice. He reported that one tug had a blown engine, another tug had broken its towline, the heliport was awash, the port drill collars had broken loose, there was 3 to 4 ft of water over the pipe rack, the drill pipe had shifted but was still in the chains, the seas were 18 to 20 ft, and there was water in the living quarters but no water in the mat. ODECO and the bargemover agreed to try to get a larger tug.

The bargemover told the Coast Guard helicopter at 2040 that assistance was not required. The drilling superintendent yelled that the helicopter was for the Marathon crew on board, and the bargemover agreed that the helicopter could come and remove them.

About 2100, with the OCEAN EXPRESS heeling about 2° to starboard and rolling 4° to 6°, the drilling derrick shifted to starboard, heeling the OCEAN EXPRESS about 2° more. The position of the derrick's locking pins had not been checked in preparation for the move.

The toolpusher, the driller, and the drilling superintendent decided to abandon ship, and ordered the men into the survival capsules. Everyone except the bargemover boarded the two starboard capsules; 14 persons boarded capsule No. 1 and 20 persons boarded capsule No. 3. The capsules were launched about 2110.

The first Coast Guard helicopter arrived shortly thereafter. The pilot observed waves breaking over the port bow and estimated that the OCEAN EXPRESS was heeled 20° to 25° to the starboard quarter. Contact was established with the bargemover via his portable radio, and he was rescued about 2115 just before the OCEAN EXPRESS capsized to starboard.

After releasing their towlines, the GULF EXPLORER and GULF KNIGHT initially proceeded to capsule No. 2, which had been washed overboard earlier, and found it inverted. They were informed by radio by the NICOLE MARTIN that no persons were inside, and the GULF KNIGHT proceeded toward capsule No. 3.

As capsule No. 1 motored away from the OCEAN EXPRESS, it developed apparent engine problems, but was able to reach the nearby survey vessel NICOLE MARTIN. The NICOLE MARTIN's crew lassoed the capsule's releasing hook and maneuvered the capsule to the bulwark opening on the vessel's lee side. All 14 persons in the capsule were transferred to the NICOLE MARTIN despite the 8-ft relative motion between the capsule and the vessel's deck. Then the capsule with its doors still open was pulled to the NICOLE MARTIN's stern, where it slipped loose from the line attached to the releasing hook. The capsule was later seen capsized.

Capsule No. 3 motored away from the OCEAN EXPRESS until the crew noticed that the GULF VIKING was following them. The driller tied the capsule's floating strobe light to a line, threw it into the water, and tied the other end of the line to the releasing hook on top of the capsule. The tug crew retrieved the floating end of the line and attached it to the tug's aft bitt. The tug's mate threw the driller a larger line with an eye and attached the other end of the line to the tug's forward port bitts. The driller slipped the eye over the capsule's releasing hook. The GULF VIKING was maneuvered to keep her stern to the sea, which left the capsule unprotected on the side of the tug. Waves pounded the capsule against the tug's side so severely that the occupants thought the capsule would shatter. They decided that the tug should tow them to shallow water, and the driller threw off the large line to the tug's forward bitt.

The capsule then either drifted or motored away from the GULF VIKING, and capsized when it was 30 to 50 ft away. Each of the five men onboard the GULF VIKING testified that the small line from the capsule had been released from the after bitt before the capsizing, but the driller testified that the line was still attached. One survivor testified that he saw the small line tighten just before the capsule capsized, and two survivors testified that they felt the capsule jerk. The tug captain and most of the capsule survivors agreed that the capsule flipped up, paused momentarily, then overturned; both crews agreed that they were hit by a large wave at the time of the capsizing.

When the GULF VIKING's crew recovered from the wave that swept their deck, they retrieved the end of the capsule's line which was floating nearby and attempted to right the capsule by pulling it, but the line broke. The crew twice attempted to right the capsule by lassoing the stabilizer with the line and pulling, but the line broke both times. A larger line also broke when the GULF VIKING pulled, and when a still larger line was used, the stabilizer carried away. Persons

began to appear in the water shortly after the stabilizer was torn off. Five persons were rescued by the GULF VIKING and two were rescued by the GULF KNIGHT. After recovering the persons who escaped from the capsule, the GULF VIKING unsuccessfully attempted to right the capsule by pulling on the rudder and propeller.

About 2245, the tugs decided they could not right the capsule and requested divers from the Coast Guard. The Coast Guard in turn requested divers from the Navy in Corpus Christi and assistance from the aircraft carrier USS LEXINGTON. About 0130, a helicopter from the LEXINGTON lowered a swimmer near the capsule, but the seas were too rough for him to connect a line to the capsule. The helicopter recovered him and hovered in the area until the LEXINGTON arrived at 0238.

The Coast Guard flew two Naval Reserve divers from Corpus Christi to the accident site. The first diver was dropped too far from the capsule, and the heavy seas and darkness prevented him from locating it. The second diver found the capsule's door open and observed stationary human legs through one of the windows about 0330. The GULF KNIGHT passed a hawser to the diver, but his efforts to find a strong attachment point on the capsule were thwarted by the heavy seas and darkness. He eventually tied the hawser to the capsule's handrail, but when the GULF KNIGHT pulled on the hawser, the handrail carried away.

The divers boarded the GULF KNIGHT and discussed further rescue plans with the Coast Guard, the LEXINGTON, and various other parties by radio. On the next dive, at 0630, the divers found the releasing hook and tried unsuccessfully to tie a line to it. Another handrail was used, but it too pulled out.

At 0726, the LEXINGTON's helicopter returned from Corpus Christi with two commercial divers to assist recovering the capsules. The LEXINGTON maneuvered alongside capsule No. 3 at 0843 and put the divers into the water. After trying to recover the capsule with a cargo net, the divers found the eyebolts in the capsule flange, and a cable and shackle were used to hoist the capsule aboard the LEXINGTON at 0942. Thirteen bodies were recovered.

Injuries to Persons

Injuries	Crew	Industrial Personnel
Fatal	9	4
Nonfatal	4	2
None	15	1

Damage to Vessels

The OCEAN EXPRESS, valued at $20 million, was a complete loss. The mat and part of the legs were eventually salvaged for scrap.

Capsules Nos. 1 and 3 were damaged during rescue and salvage attempts. Capsule No. 2 was found inverted on a Texas beach with its dome severely damaged.

Inspection of the GULF KNIGHT's starboard reduction gear showed that a metal bolt had become lodged in the gear teeth. The source of the bolt could not be positively determined.

Crew Information

The ODECO bargemover was in command of the unit during moving operations. The ODECO toolpusher, who was in charge during drilling operations, supervised the two ODECO drilling crews and the housekeeping staff. Normally, the bargemover would assume command when the unit was secured and ready to begin a move. He would be in charge of jacking operations, tug placement, and ballasting until the move had been completed and the unit jacked up and ready to drill at the new location.

The Marathon drilling superintendent supervised the other six industrial personnel on board. These persons were involved only in well drilling operations and had no duties during a move.

The bargemover was properly licensed. He had 7 years experience as an ODECO bargemover and had moved the OCEAN EXPRESS twice previously. None of the other crewmembers were licensed or documented, nor were they required to be.

Vessel Information

OCEAN EXPRESS

The OCEAN EXPRESS was owned by ODECO and leased for drilling operations by Marathon. It was constructed in 1975 by Bethlehem Steel Corporation.

The OCEAN EXPRESS was a special purpose vessel for drilling oil wells in water depths up to 250 ft. When drilling, the OCEAN EXPRESS' platform was jacked 25 to 40 ft above the water. When moving to a new drilling site, the platform was jacked down to its floating position and the mat was raised off the bottom. For a field move 3/, the mat was raised sufficiently to clear the bottom along the transit route. For ocean transit 4/, the mat was raised to within 2 ft of the platform, and the top 36 ft of each column was removed to preclude structural damage from seaway-induced motions.

3/ A field move is a move during which the unit is not more than 12 hours from sheltered waters or a location where it could be jacked up.
4/ Ocean transit is any move other than a field move.

The platform was a bargelike structure, about 166 ft long, 109 ft wide, and 16 ft deep, with a notch in the after end and a cantilevered helicopter deck on the forward end. (See figures 1 and 2.) The derrick was mounted on transversely and longitudinally movable skids that traveled on longitudinal tracks on the main deck at the notch. The superstructure contained the galleys, recreation and mess rooms, offices, quarters, laundry, stores, and radio room. The lower deck contained mud pits, machinery spaces, storerooms, and quarters. The innerbottom tanks were used for fuel oil, drilling water, potable water, ballast, and void spaces.

The mat was a submersible, A-shaped structure about 210 ft long, 170 ft wide, and 10 ft deep. A heavily reinforced, 2-ft-deep skirt was attached to the bottom perimeter to prevent currents from scouring out the ocean bottom under the mat. The mat was divided into permanently flooded and permanently buoyant compartments. Three tubular columns, 12 ft in diameter and 312 ft long, connected the mat and platform.

Towing padeyes which could accommodate several towlines were on the main deck in recesses in the forward superstructure. Two double mooring bitts were installed on the aft, outboard corners of the main deck. There were no mooring fittings or towing padeyes on the upper deck. The OCEAN EXPRESS did not carry a spare towline, nor was it required to carry one.

Bethlehem wrote the OCEAN EXPRESS' operating manual, which contained physical data, drawings, operating limitations, stability information, and jacking system operating instructions. The bargemover was familiar with the operating manual and its contents. The toolpusher knew the manual was on board but was not familiar with it.

A Bethlehem witness testified that the mat could be set on the bottom and the platform jacked out of the water in 9.5-ft seas with only some jacking pin hole damage. He also indicated that if the sea state worsened during a tow and was going to deteriorate further, the mat should be retracted completely if near full retraction, or the unit should be set on the bottom if the mat were near the bottom. This information was not in the operating manual.

An ODECO witness testified that ODECO did not review the operating manual. ODECO did not require that any particular information be included in the operating manual, nor did they modify it in any way. The Coast Guard and the American Bureau of Shipping (ABS) determined that the OCEAN EXPRESS' operating manual met their respective requirements.

OCEAN EXPRESS

(SHOWN WITH MAT POSITIONED FOR 148' DRAFT)

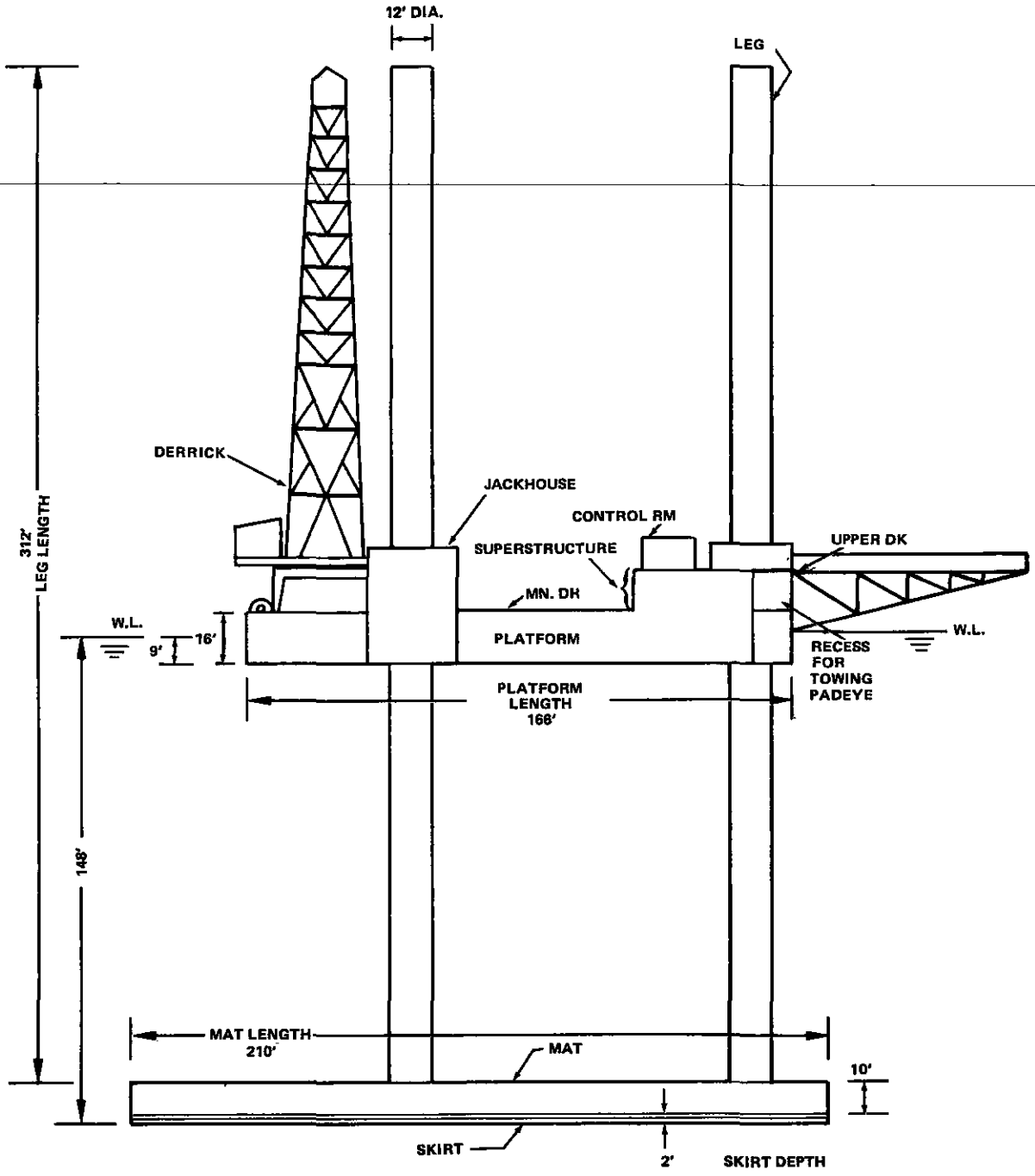
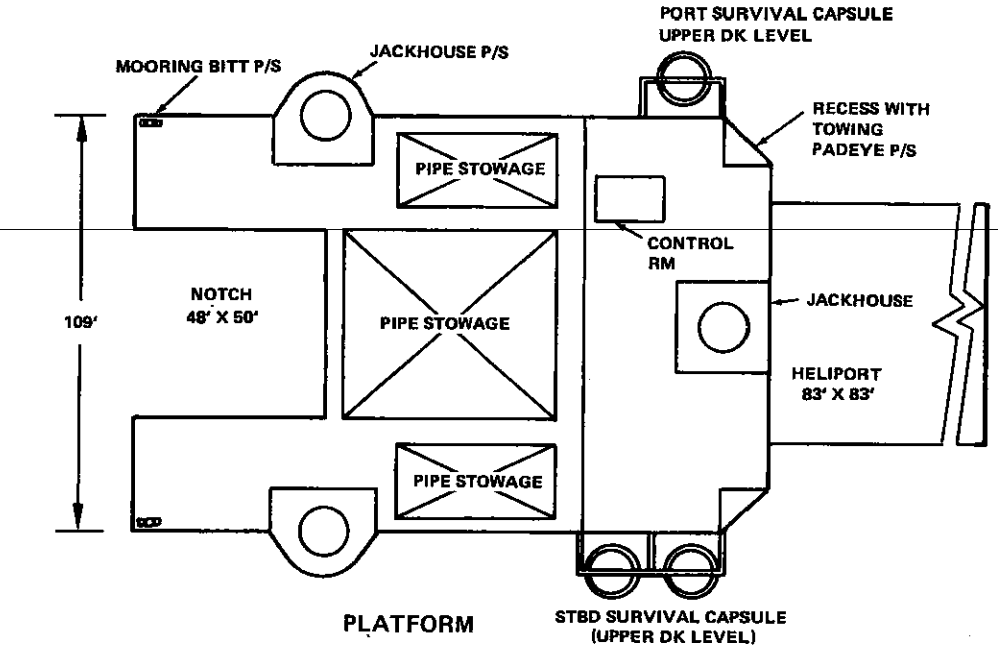


Figure 1. Profile view.

OCEAN EXPRESS



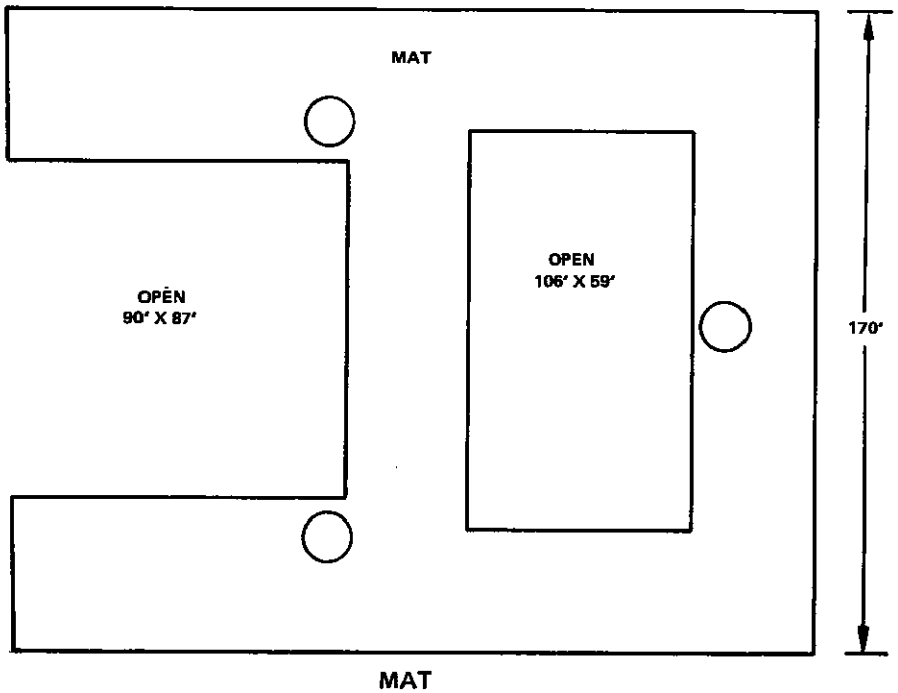


Figure 2. Plan views.

The operating manual contained the following warning:

"Platform is not to be jacked out of or down into water when sea state is such that maximum combined height of wave plus swell exceed 7.0' or when maximum height of swells exceed 3.0' (when in water depths exceeding 200', it is recommended that platform not be jacked out of or down into water when maximum combined heights of wave plus swell exceed 5.5', except in emergencies)."

The operating manual contained little or no information regarding:

1. The stability of the unit for the complete range of mat-platform separations.

2. The number of tugs and the horsepower required for towing the unit, and the recommended towing arrangements and equipment.

3. Contingency plans for emergencies afloat, including towing mishaps and severe weather.

4. Guidance and a checklist for transit preparations.

5. The expected results of exceeding the design limits for jacking operations.

6. The minimum wind speeds, sea conditions, and unit motions which would result in instability or structural failure.

The OCEAN EXPRESS was classed by the ABS as a "Self Elevating Drilling Unit." The construction plans were reviewed, and the unit was inspected during construction to insure compliance with the 1973 ABS "Rules for Building and Classing Offshore Mobile Drilling Units." In the survival condition (2-ft mat-platform separation), the unit met the ABS stability criteria for 100-kn winds. In other conditions, the unit exceeded the ABS stability criteria for 70-kn winds. The OCEAN EXPRESS had a valid International Load Line Certificate. The unit was not inspected by the Coast Guard, nor was it required to be.

The OCEAN EXPRESS did not carry line-throwing equipment or flares. The unit was not equipped with instruments to measure wave height, water depth, or the amplitude of the unit's roll, pitch, and heave. None of this equipment was required. The OCEAN EXPRESS did carry a recording anemometer.

Survival Capsule

The OCEAN EXPRESS carried three Whittaker Corporation model 9091 survival capsules. This model capsule was designed for escape from offshore oil platforms and nearby floating oil fires. It had a single-line, gravity launching system and was equipped with water sprinkling and air filtration systems. (See figures 3 and 4.) Miscellaneous supplies and equipment, including flares, were fitted in accordance with Coast Guard regulations. The capsule was designed for operation by industrial personnel with minimal seamanship and boathandling skills.

The Coast Guard reviewed the survival capsule in accordance with the regulations for open lifeboats and approved them for use on offshore mobile drilling units and fixed platforms. The capsule performed satisfactorily during Coast Guard certification tests, including floating while flooded, heeling because of off-center passenger loading, hull strength, launching, and towing. For the towing test, the towline was secured to the holding eyebolt on the capsule's flange. The capsule was not tested in severe storm conditions, but Whittaker voluntarily submitted to the Coast Guard a model test report which indicated that the capsule would not capsize in 7-ft waves. The capsule was not self-righting, nor was it required to be.

As part of its installation service, Whittaker provides training in the proper use of the capsule. A training film, which states that the capsule cannot capsize, is normally shown. A lecture is given, and when possible, a capsule is launched and operated under Whittaker supervision. This training had been provided to OCEAN EXPRESS crewmembers, but because of crew changes, few of the trained crewmembers were on board on the day of the accident.

Whittaker recommended that the capsule not be towed, but left to drift if conditions are too dangerous to transfer the occupants to a rescue vessel. This is not indicated in the capsule's operating instructions or in the training. No towing or mooring fittings are installed on the capsule, and the holding eyebolts on the flange cannot be reached from inside the capsule. No fenders are provided on the capsule's flange.

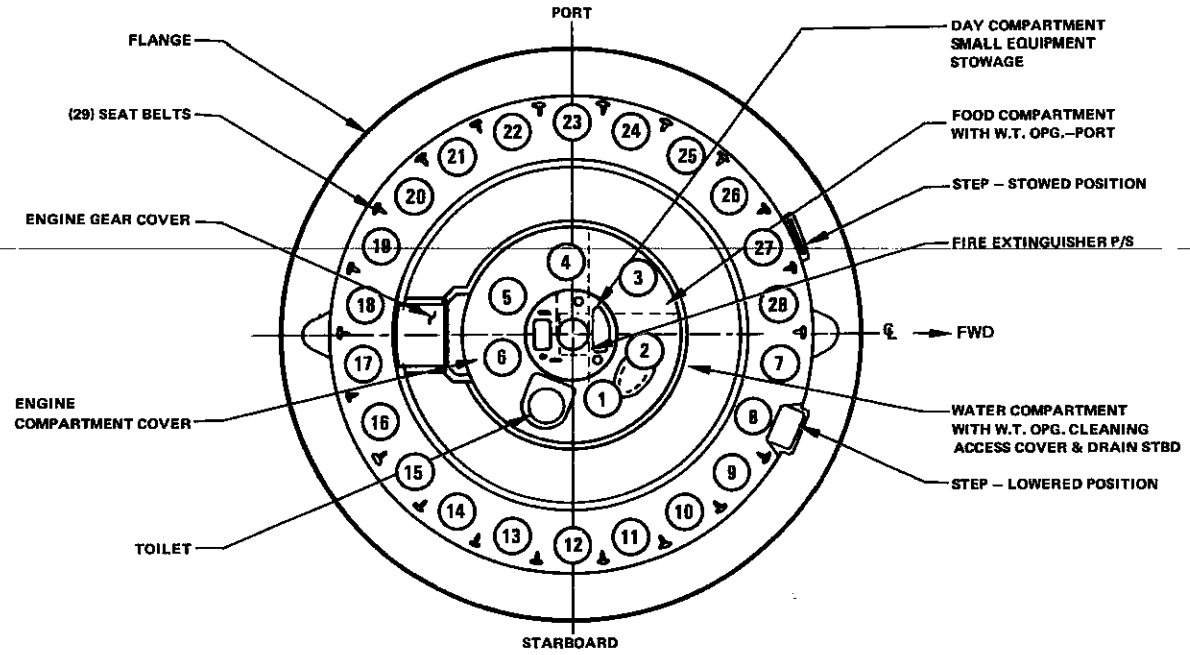
The capsule has been used for escape from other accidents during storm conditions; however, the available information indicates that these conditions were less severe than those encountered during this accident. In one case a capsule was towed in moderate seas using a 150-ft towline.

Waterway Information

The OCEAN EXPRESS sank in the Gulf of Mexico about 28 nmi south of the coast near Port O'Connor, Texas. The ocean bottom is soft mud with a gentle slope toward the shore. This area is not protected from southerly through easterly winds and waves.

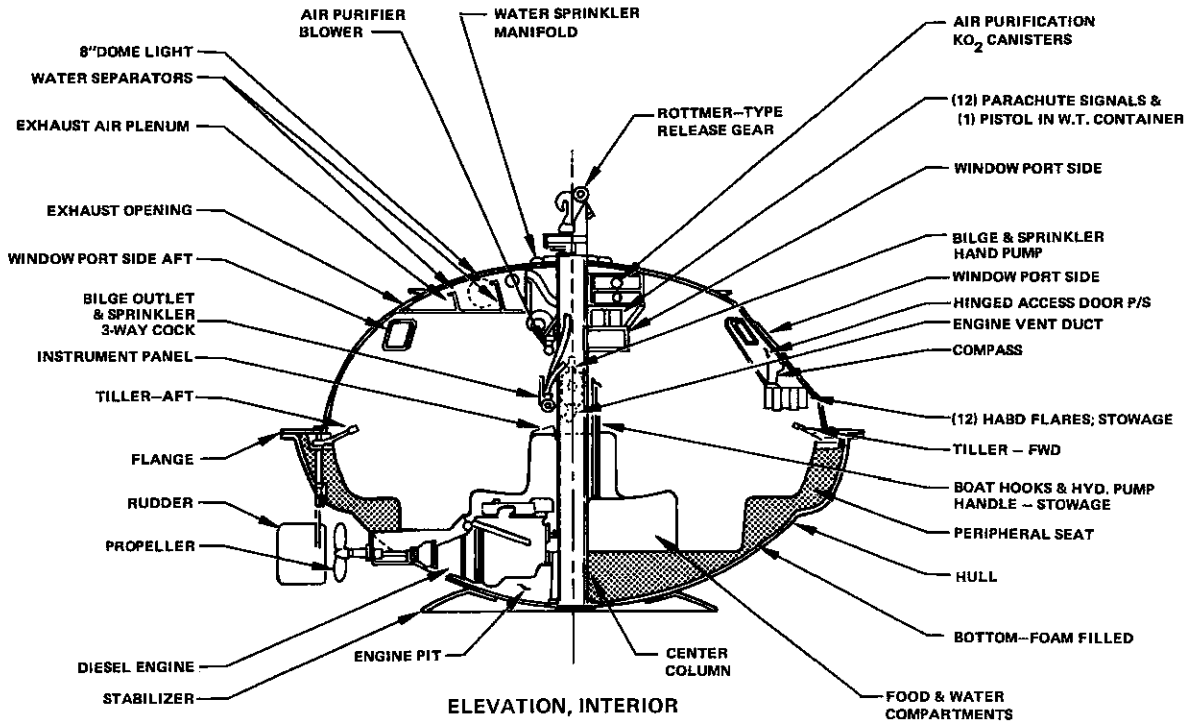
Figure 3

WHITTAKER SURVIVAL CAPSULE



PLAN VIEW, INTERIOR

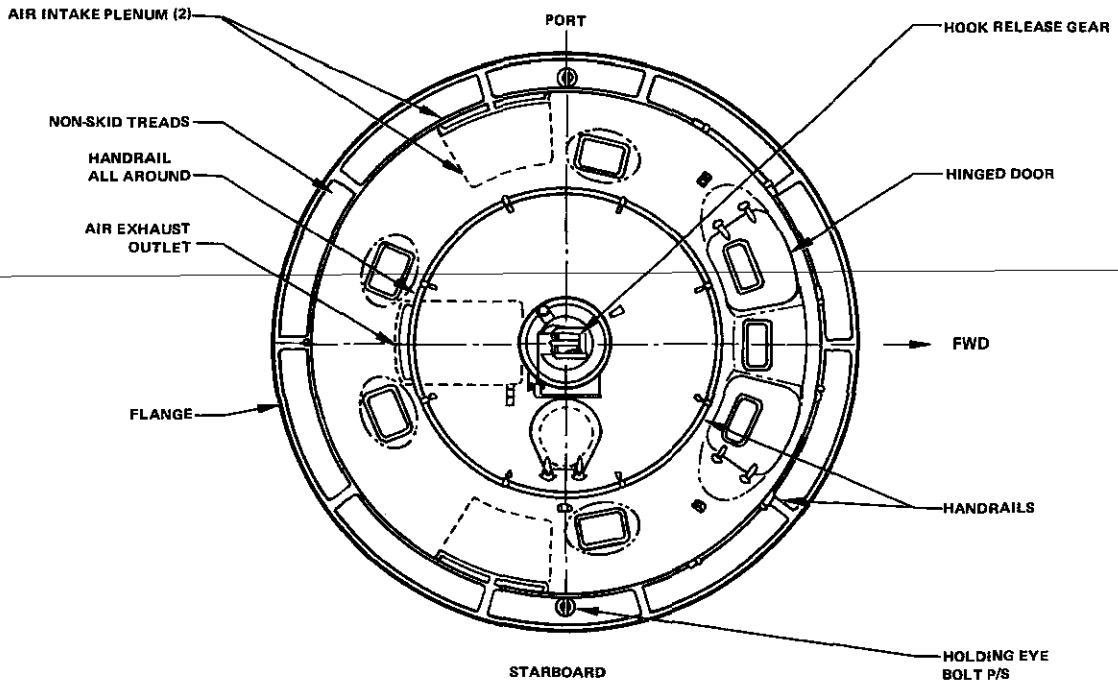
SEATING ARRANGEMENT



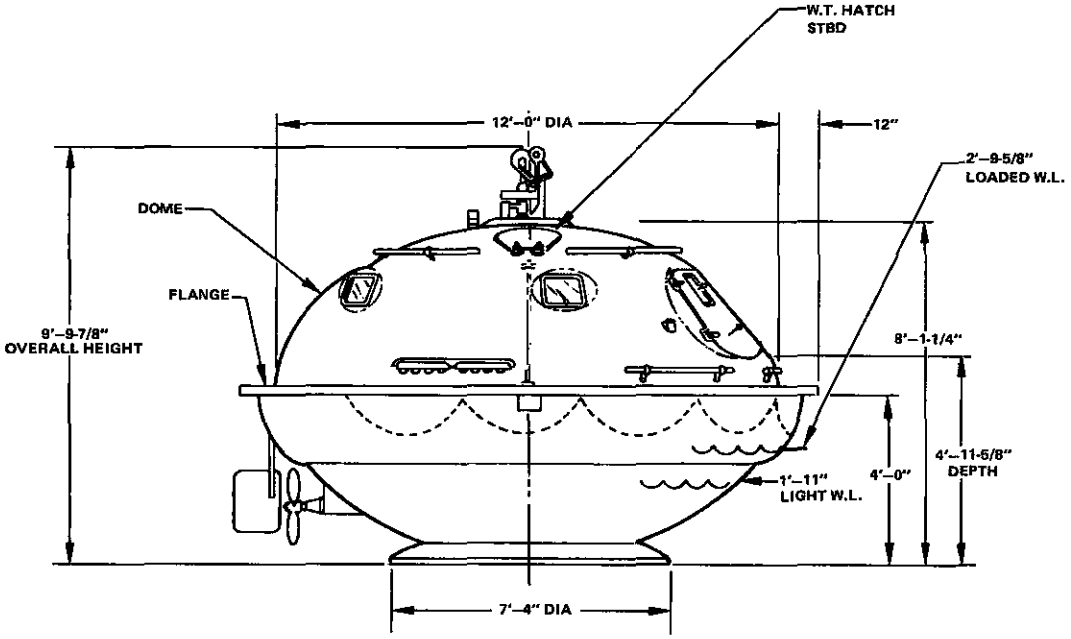
ELEVATION, INTERIOR

Figure 4

WHITTAKER SURVIVAL CAPSULE



TOP VIEW, EXTERIOR



ELEVATION STARBOARD SIDE
PORT SIDE SIMULAR EXCEPT AS NOTED

EXTERIOR

Based on weather observations made by ships passing through this Texas coastal area during the months of April, the prevailing wind direction is southeast. The percentage frequencies of wind speeds of 34 kns or more and wave heights of 10 ft or more are about 0.5 and 2.9, respectively. 5/

Meteorological Information

When jacking down the OCEAN EXPRESS' platform on the morning of April 14, 1976, the bargemover estimated the seas to be 4 to 6 ft with very little swell. At 0600, the toolpusher and the drilling superintendent had reported 4- to 6-ft seas and 25- to 30-mph winds. The captain of the GULF VIKING estimated the seas to be 5 to 7 ft.

From 0900 through 2300, the meteorological staff on board the LEXINGTON, which was within about 25 nmi of the OCEAN EXPRESS, reported 2-ft seas and 5-ft swells. The reports indicated that the wind speed increased from about 17 kns to about 29 kns during this period. (Appendix B contains a condensed tabulation of weather observations made by the LEXINGTON's meteorological staff.)

When the bargemover began jacking down the OCEAN EXPRESS' mat during the evening of April 14, he estimated the seas to be 5 to 7 ft, and the drilling superintendent estimated the seas to be 6 to 8 ft. When jacking was discontinued about 0100, April 15, the toolpusher estimated the seas to be 7 to 8 ft, and the drilling superintendent estimated 6- to 8-ft seas with 10-ft swells. For most of the morning, the LEXINGTON reported 2-ft seas with 7-ft swells and wind speeds between 17 and 37 kns. The bargemover testified that the seas had increased to 10 to 12 ft by 1400.

The wind and seas continued to increase during the afternoon of April 15. The GULF VIKING's mate estimated 25-ft seas at 1930. At 2100, the LEXINGTON reported 52-kn winds, 7-ft seas, and 17-ft swells. When the OCEAN EXPRESS capsized, the drilling superintendent estimated 15-ft seas with 20- to 25-ft swells, and the toolpusher estimated 18- to 20-ft seas with 15-ft swells.

The National Weather Service (NWS) forecast office at San Antonio, Texas, prepared marine weather forecasts for the Texas coastal waters from Port O'Connor to Port Arthur within 50 miles offshore. These forecasts were broadcast from the NWS Corpus Christi and Galveston VHF weather radios. On April 14, the forecasts indicated about 3- to 6-ft seas, and on April 15, 5- to 8-ft seas were initially forecasted. Additional forecasts indicating 6- to 10-ft seas were issued at 1745 and 2025, and the 2110 forecast indicated gusty winds to 55 kns and 10- to 15-ft seas. (See Appendix B.)

5/ United States Coast Pilot, Atlantic Coast: Gulf of Mexico, Puerto Rico, and Virgin Islands, National Oceanic and Atmospheric Administration, 1977.

Marathon received specialized weather forecasts from a private meteorological service. These forecasts included a general weather synopsis, severe weather predictions, and 24- and 48-hour wind and wave forecasts. Wave height predictions for specific lease blocks were given, and on April 14 and 15, these predictions were about 2 to 3 ft higher than the NWS sea height forecasts. (See Appendix B.)

The bargemover testified that while on board the OCEAN EXPRESS, he obtained weather forecasts solely from the NWS weather radio broadcasts. He listened to these broadcasts during the afternoon of April 13, and several times on April 14 and 15. The bargemover believed that the NWS forecasts were, in general, reliable.

About 0900, April 15, the drilling superintendent's concern about the difference between the actual weather conditions and the NWS forecasts led him to obtain the 0600 private meteorological service forecast. He testified that he gave the forecast's wind and wave information to the bargemover, but the bargemover did not remember receiving it.

An NWS meteorologist testified that the NWS marine forecasts are general forecasts geared toward small craft operators. He indicated that NWS cannot provide specialized service for specific users with routine forecasts. Another NWS witness testified that NWS encourages the use of private meteorological services for special needs. At the time of the accident, NWS had limited data collection capabilities in the western Gulf of Mexico, but, since the accident, two automatic weather data buoys have been installed to provide additional data for this area.

Wreckage

The OCEAN EXPRESS wreckage was found in Matagorda Island lease block A9 (27°52'N, 96°18'19"W) in about 167 ft of water. The main deck was resting on the bottom and a corner of the mat was breaking the water surface.

Medical and Pathological Information

Autopsy reports indicate that all deaths were caused by drowning.

Survival Aspects

The accident was survivable. All of the crewmembers had assembled on the upper deck, fully clothed and wearing lifejackets, when they were ordered to abandon the OCEAN EXPRESS. Although the survival capsule on the port side had been washed away earlier, the two survival capsules on the starboard side were accessible and operable. Even though only a few crewmembers had experience launching and operating the capsules, both were successfully launched and steered away from the OCEAN EXPRESS.

Survivors' testimony indicates that the occupants of capsule No. 1 remained reasonably calm and handled the capsule in an orderly manner. There was no panic or confusion. Each man waited for his turn to jump from the capsule to the NICOLE MARTIN.

There was much confusion on board capsule No. 3. Although the toolpusher, driller, and drilling superintendent were on board, no one was effectively controlling the occupants. The driller unsuccessfully attempted to take charge, and then followed instructions shouted at him by others.

Although all of the occupants of capsule No. 3 wore lifejackets and most had unfastened their seatbelts, there were no immediate attempts to escape from the capsule when it capsized. The water in the capsized capsule initially rose above the doors, and continued to rise until only a small air pocket remained. Two survivors then made deliberate efforts to escape from the capsule; the other five are not sure how they escaped.

Other Information

The total horsepower of the three tugboats used to move the OCEAN EXPRESS was about 8,000. The OCEAN EXPRESS model test report indicates that this horsepower was adequate for towing in seas of about 12-ft significant wave height. 6/ Although the total horsepower used on previous moves varied from about 10,000 to 14,000, ODECO considered the horsepower of the tugs used for this move to be adequate.

For ocean tows, a spare towline is often stowed aboard the towed vessel so that the tug can be quickly reconnected if the primary towline breaks.

Calculations made by the Safety Board's staff indicated that the forces exerted by the wind and waves may have been sufficient to capsize the OCEAN EXPRESS if the mat grounded. Calculations also showed that the reduction in stability caused by the shifting of the derrick and deck cargo would not have been sufficient to capsize the unit. Calculations made by the Coast Guard and Bethlehem showed that lowering the mat from the survival condition to the 148-ft draft position would reduce the OCEAN EXPRESS' maximum righting arm and range of stability about 35 percent. The bargemover was not aware that the OCEAN EXPRESS' stability decreased when the mat was lowered from the survival condition.

On December 4, 1978, the Coast Guard published regulations for the inspection, certification, design, equipment, and operation of mobile offshore drilling units. Requirements for flares, line-throwing appliances, operating manuals, and weekly emergency drills are included.

6/ Significant wave height is the average height of the one-third highest waves in a particular sample.

Model tests and actual experiences have shown that disc-shaped buoys similar in hull form to the survival capsule are particularly susceptible to capsizing in breaking waves when the wave height to hull diameter ratio is greater than about 1.5. Tethering the buoys has little effect on the capsizing. 7/

Monitoring motion amplitudes and periods to increase the operability and safety of crane ships has been successful. Data from motion sensors and wave measuring instruments can be analyzed by an onboard computer to predict ship motions. 8/

ANALYSIS

OCEAN EXPRESS Capsizing

By the evening of April 15, the OCEAN EXPRESS was in an untenable situation. The GULF KNIGHT's starboard reduction gear had failed, and the GULF VIKING's towline had broken. The efforts to reconnect a towline had failed. The remaining functional tugboat, GULF EXPLORER, could not hold the unit in position or bow into the seas. The unit had turned broadside to the more than 20-ft seas and 50-kn winds. Waves were continually washing over the deck, and the OCEAN EXPRESS was drifting toward the shore.

Before the OCEAN EXPRESS capsized, deck cargo and the derrick had shifted to starboard, increasing the unit's heel slightly. However, these weight shifts and the small increase in heel were not sufficient to capsize the unit. Some flooding had been observed, but the crew was actively engaged in stopping leaks and pumping out accumulations of water. It is not likely that sufficient water accumulated before the unit was abandoned or that sufficient additional flooding occurred so quickly after abandonment to cause the capsizing. However, the combination of these factors would have made the OCEAN EXPRESS easier to capsize.

Combined with the 148-ft still water draft, the unit's trim aft and starboard heel caused about a 165-ft draft at the aft, starboard corner of the mat. The OCEAN EXPRESS wreckage was found in about 167 ft of water, indicating the possibility of grounding. Although the crew did not report any indications of grounding, the unit was rolling, pitching, and heaving because of wave action, and they were probably too preoccupied with evacuation to notice grounding in the soft mud. The unit capsized to starboard, which would be expected if a starboard part of the mat had grounded. Calculations indicated that the wind and wave forces may have

7/ G. L. Petrie, "An Evaluation of the Capsizing Behavior of Discus Buoys at Several Locations," July 1978, Hoffman Maritime Consultants, Inc., Glen Head, New York.

8/ D. Hoffman and V. K. Fitzgerald, "Systems Approach to Offshore Crane Ship Operations," The Society of Naval Architects and Marine Engineers, November 1978.

been sufficient to capsize the unit if the mat grounded. The Safety Board concludes that the OCEAN EXPRESS was capsized by wind and wave forces after grounding.

The OCEAN EXPRESS was equipped with two towing padeyes in the superstructure recesses forward and two sets of mooring bitts aft. Boarding seas thwarted the attempt to retrieve the broken towline forward and rig a new line to it. Loose deck cargo and boarding seas prevented safe access to the bitts aft. After failing to secure a line to a crane foundation and with no line-throwing equipment or coordinated plan of action, the OCEAN EXPRESS and GULF VIKING crews essentially abandoned their efforts.

Since the OCEAN EXPRESS' towing padeyes could accommodate several towlines, spare towlines could have been rigged when the move began. The spare towlines could have been stowed on the upper deck and would have been accessible in heavy weather. If this precaution had been taken, the GULF VIKING probably could have been reconnected, and the capsizing might have been prevented. The Safety Board concludes that contingency plans for towing emergencies should be made before moving a mobile drilling unit.

Weather and Sea Conditions

Analysis of the meteorological factors pertinent to this accident shows that a north-south oriented cold front was about 240 nmi west of the accident location at 1800 on April 15. The weather east of the front was characterized by a tightening pressure gradient and increasing southeast winds during the 48 hours before the accident. An effectively unlimited fetch was provided for the generation of wind-driven seas, and the analysis shows no weather system which could have caused southeasterly swells near the OCEAN EXPRESS. The waves near the OCEAN EXPRESS were generated by the weather system which affected the western Gulf of Mexico on April 13, 14, and 15, and, therefore, would be considered wind-driven seas.

When the move began on the morning of April 14, persons on the unit estimated 4- to 7-ft seas. The LEXINGTON reported 2-ft seas and 5-ft swells, which result in a combined sea of about 5.4 ft. However, since a southeasterly swell was reported, it is likely that the LEXINGTON's observers reported the higher, longer-period wind waves as swells. The NWS forecasted up to 6-ft seas, and the OCEAN EXPRESS' operating manual indicated a jacking limit of 7-ft seas. The Safety Board concludes that the existing and NWS-forecasted sea conditions were satisfactory for the move when it began.

After the OCEAN EXPRESS arrived at the new drilling site and jacking was discontinued about 0100, April 15, persons on the unit estimated 6- to 8-ft seas. The drilling superintendent additionally estimated

10-ft swells, but he too probably misinterpreted the higher, longer-period wind waves as swells. The Safety Board's analysis of the meteorological factors indicates that the significant wave height may have been as high as 10 ft. Based on this analysis and the wind speed increase reported by the LEXINGTON, and considering the inaccuracies associated with night sea observations, the Safety Board concludes that the significant wave height was about 9 ft when jacking was discontinued at the new drilling site.

At 2100 and 2200, April 15, the LEXINGTON reported 7-ft seas and 17-ft swells. The drilling superintendent estimated 15-ft seas with 20- to 25-ft swells, while the toolpusher estimated 18- to 20-ft seas with 15-ft swells. However, it is difficult to differentiate between wind-driven sea waves and swell waves when the wave height exceeds about 10 ft, especially at night when it is difficult to see far enough to observe the long wave trains of swell. Again, the observed seas were probably largely composed of wind-driven waves. The GULF VIKING's mate estimated 25-ft seas with no indication of swell at 1930. The Safety Board's analysis of the meteorological factors indicates that the significant wave height at 2100 could have been as high as 24 ft. Considering this analysis and on-scene observations, the Safety Board concludes that the significant wave height was between 20 and 24 ft when the OCEAN EXPRESS capsized.

At 1400, April 15, the private meteorological service forecasted 10- to 13-ft seas with maximum wave heights of 18 ft. At 2110, NWS forecasted 28- to 38-kn winds with gusts to 55 kns and 10- to 15-ft seas. The LEXINGTON recorded sustained winds of 52 kns with peak gusts of 60 kns at 2100, and the significant wave height was between 20 and 24 ft. The Safety Board concludes that the NWS and private meteorological service forecasts pertinent to the time and place of the accident were substantially in error.

In reality, it is moot whether significant "swell" was observed during the progression of events leading to this casualty. While the OCEAN EXPRESS' jacking limits were given in terms of "sea" and "swell", the controlling elements would have been the unit's seaway-induced motion amplitudes and periods. The level of noise created by the jacking operation would have been some indication of approaching the jacking limits. The unit probably would have reacted more adversely to long-period, regular waves (typically swell) than to shorter period, irregular waves (typically wind-driven sea) of the same height. This is supported by the lower wave height limit for swell. Recorded motion data would indicate more accurately than a subjective evaluation of the existing sea state or noise level when unit motions approach a critical operational limit.

Since the OCEAN EXPRESS did not have instruments to measure wave heights, the bargemover relied on weather forecasts and visual observations. The bargemover obtained weather forecasts solely from the NWS weather radio broadcasts. Comparing the forecasts with the observed conditions, it is evident that the private meteorological service forecasts for April 14 were more accurate than the NWS forecasts. The private forecasts indicated that the seas could exceed the OCEAN EXPRESS' jacking limits, but no such indication existed in the NWS forecasts. The NWS marine forecasts are geared toward small craft operators and do not provide specialized information for specific marine operations. The private forecasts presented more information in a more useful format. The Safety Board concludes that private meteorological services should be consulted for the special information needed.

OOCEAN EXPRESS Operating Manual

The Load Line regulations at 46 CFR 42.15-1(b) require that "the master of every new vessel...be supplied with sufficient information in a form approved by the Commandant, to give him guidance as to the stability of the vessel under varying conditions of service." Section 1.11 of the ABS rules requires operating manuals to contain "instructions for operation of the unit including adverse weather" and "representative examples of loading conditions for each mode of operation." The OCEAN EXPRESS' operating manual did not contain stability information for the complete range of mat-platform separations, and the bargemover was not aware that the unit's stability decreased as the mat was lowered. The manual did not contain instructions for adverse weather operations under tow. The position of the mat was left to the bargemover's discretion for field moves, but he did not have sufficient stability and structural information to help him decide on the best mat position for a particular move. This information should have been in the operating manual.

Bethlehem had the primary responsibility for the content of the operating manual. It is difficult for a builder to be aware of the unusual situations in which operators may find themselves and to presuppose all possible emergency situations. However, this does not relieve Bethlehem of its responsibility to provide pertinent information for normal operations and foreseeable emergencies. The probable results of jacking in sea states that exceed the design limits and information regarding mat position during a tow in worsening weather were not included in the manual. This information would have been useful to the bargemover and should have been in the operating manual, even though not required by Federal regulations.

Although the operating manual prohibited jacking operations in more than 7-ft seas, the unit could be jacked in 9.5-ft seas with only some jacking pin hole damage. Since the significant wave height was only about 9 ft when the bargemover halted jacking operations at the new location, the jacking operations probably could have been continued.

The platform probably could have been raised successfully out of the water, and the casualty may have been avoided.

Although the wind and seas were gradually increasing, there is no indication that the seas exceeded 10 ft until the bargemover estimated about 10- to 12-ft seas at 1400, April 15. Therefore, a period of about 12 hours was available to jack the platform out of the water, and the jacking operation could have been completed in about 3 to 4 hours. However, the NWS weather forecasts did not show cause for great concern. Lacking an indication of the results of jacking in 9.5-ft seas, the bargemover could not reasonably have decided to continue jacking unless faced with an emergency, and during this time the OCEAN EXPRESS was not in immediate danger. It may have been possible to jack the platform out of the water in even higher sea states, but the operating manual did not indicate the sea state that would make the jacking mechanically or structurally impossible.

Although the primary purpose of a self-elevating unit is to drill wells while elevated, field moves are a normal and frequent operation. It should be expected that severe weather might be encountered or that some towing mishap might occur during a move. The operating manual, however, did not indicate any suggested corrective actions for such emergencies. The unit's bow should be held into severe seas, but the tug horsepower and towline or bridle arrangement necessary was not shown. If the GULF EXPLORER had been repositioned to the bow on the morning of April 15, it would have been easier to hold the bow into the seas. The subsequent loss of the GULF VIKING's towline may have been prevented because the strain would have been reduced. Even if the towline did break, the GULF EXPLORER would have been in a far better position to hold the bow into the seas, and the loss of directional control of the OCEAN EXPRESS may have been prevented. Although the bargemover might be expected to properly position the tugs at all times, appropriate guidance in the operating manual should be available. The Safety Board considers the lack of complete information in the unit's operating manual to be a contributing cause to this casualty.

Survival Capsules

There is conflicting testimony regarding the events that occurred just before the No. 3 survival capsule capsized. Some persons inside the capsule believed that the small line was still attached to the capsule's releasing hook and the GULF VIKING's aft bitt, but the tug's crewmen all testified that the line had been released. However, capsule survivors and the tug crew agreed that they were hit by a large wave when the capsule capsized.

The capsule's response characteristics are undoubtedly nonlinear in heavy seas, so the model tests cannot be extrapolated to predict the capsule's response to the more than 20-ft seas. Although the capsule

was not tested in severe seas and there are no conclusive case histories, the capsule can be compared to a disc-shaped buoy. The significant wave height when the OCEAN EXPRESS capsized was about 20 to 24 ft, so waves as high as 30 ft would be expected. The capsule's diameter was about 13 ft. The ratio of wave height to capsule diameter was, therefore, greater than about 1.5, which has been shown to be critical for disc buoy's capsizing in breaking waves.

Considering the conflicting testimony, the amount of tripping force, if any, exerted upon the capsule through the small line cannot be determined. However, all three capsules became inverted, and there is no indication that capsules Nos. 1 and 2 were pulled over. Partial flooding through the open doors probably aided the No. 1 capsule's capsizing. The Safety Board concludes that capsule No. 3 was capsized by extreme wave action alone or in combination with a tripping force imparted through the small line.

The Coast Guard lifeboat regulations were written specifically for open lifeboats using traditional concepts. An enclosed survival capsule is significantly different from an open lifeboat and has unique characteristics. Thus, open lifeboat performance standards would not necessarily address those areas where survival capsules may have weaknesses. The capsule's capsizing and righting characteristics in a seaway and persons' escape from an overturned capsule were not considered adequately in the approval process, and this casualty shows that survival capsules do have weaknesses in these areas. The Safety Board concludes that performance standards which consider the unique capabilities and weaknesses of survival capsules should be developed.

In consideration of the intended users of the capsule, Whittaker's training program should include guidance for towing, securing alongside another vessel, and emergency escapes. Although Whittaker recommended that the capsule not be towed, lifeboats and liferafts are often towed during rescues, especially when heavy seas make personnel transfer dangerous. It should have been anticipated that survival capsules also would be towed, especially since a towing test was required for Coast Guard approval. Although survival capsules have been towed successfully, their towing limitations are not known. The capsule's towing characteristics should be determined, and proper towing equipment should be fitted on the capsule. Lifeboats and other small rescue craft are often secured to larger assisting vessels when transferring personnel. The personnel transfer operation traditionally has been one of the most dangerous parts of a rescue, so particular efforts should be made to reduce the risks. Accessible mooring fittings and proper fendering would reduce the possibilities of injury.

Even though it would have been easier to escape from a capsized lifeboat, the survival capsules were the best available equipment for use by inexperienced industrial personnel. The capsule can be launched

with ease and can travel through floating oil fires. In this accident, boarding rafts from the upper deck would have been difficult because the crew would have had to slide down a line about 12 ft to the water.

OCEAN EXPRESS Chain of Command

Although the bargemover was technically in command during moving operations, the toolpusher was normally in charge of the OCEAN EXPRESS and the crew. The bargemover was on board only during the relatively short time periods when moving the unit, and it was natural for the crewmembers to expect direction from their usual supervisor, the toolpusher, during extreme situations. The industrial personnel on board were involved in well drilling operations only, and naturally expected direction from their usual supervisor, the Marathon drilling superintendent. In this circumstance, it would be difficult for the bargemover to exercise effective control unless the other leaders overtly deferred to him.

The toolpusher and drilling superintendent decided that the seas were too rough for jacking at 0100 on April 15, and apparently convinced the bargemover to stop the jacking operation. The driller unilaterally sounded the unit's alarm, and the drilling superintendent made the distress call. The toolpusher, driller, and drilling superintendent decided to abandon the unit and ordered the men into the survival capsules. It is, therefore, evident that the other leaders on board did not defer to the bargemover nor reinforce his command stature.

Since the bargemover did not believe that assistance was required at 2040 on April 15 and would not board the survival capsules only a few minutes before the OCEAN EXPRESS capsized at 2115, it is fortunate that unilateral actions were taken in this case. However, the preemption of command initiative in other crisis situations could have disasterous results.

Since the bargemover is on board for only short time spans and probably could act effectively as an advisor, it seems imprudent to give him final authority. On the other hand, the toolpusher would need additional seafaring training to command the unit during moves. In any event, the chain of command must be absolutely clear at all times to all persons on board. The Safety Board believes that the chain of command must function in all situations, and minimal changes in command would make this more certain. Whoever commands the unit should command it at all times, and an effective chain of command should be developed and required.

CONCLUSIONS

Findings

1. The existing and NWS-forecasted sea conditions were satisfactory for the OCEAN EXPRESS' move when it began.

2. The private meteorological service forecasts for April 14, 1976, were more accurate than the NWS forecasts.

3. Private meteorological services should be consulted for the special weather information needed for offshore oil exploration operations.

4. The NWS and private meteorological service forecasts pertinent to the time and place of the accident were substantially in error.

5. Shifting of the deck cargo and drilling derrick and some flooding made the OCEAN EXPRESS easier to capsize.

6. The OCEAN EXPRESS was capsized by wind and wave forces after grounding.

7. Contingency plans for towing emergencies should be made before moving a mobile drilling unit.

8. The OCEAN EXPRESS' operating manual did not contain complete structural, stability, and operating information or appropriate guidance for emergency situations.

9. The No. 3 survival capsule capsized because of extreme wave action alone or in combination with tripping forces imparted by a small line attached to the rescue tug.

10. Performance standards which consider the unique capabilities and weaknesses of survival capsules should be developed.

11. Survival capsules should have accessible towing and mooring fittings and proper fendering.

12. Survival capsules provide an effective means of evacuation from self-elevating drilling units.

13. The designated chain of command on the OCEAN EXPRESS did not function effectively.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the complete loss of control of the OCEAN EXPRESS because of equipment failures on two of the three assisting tugs, which allowed the unit to turn broadside to the wind and seas, drift, ground, and capsize. Contributing to the accident were the lack of preparation for towing emergencies, the lack of complete information in the unit's operating manual, and the inaccuracy of the National Weather Service's weather forecasts.

Contributing to the loss of life was the capsizing of the No. 3 survival capsule because of extreme wave action alone or in combination with tripping forces imparted by a small line attached to the rescue tug.

RECOMMENDATIONS

As a result of its analysis of this accident, the National Transportation Safety Board made the following recommendations:

--to the U.S. Coast Guard:

"Require that operating manuals for self-elevating mobile offshore drilling units include guidance regarding:

1. The stability of the unit for the complete range of mat-platform separations;

2. the number of tugs and the horsepower required for towing the unit, and the recommended towing arrangements and equipment;

3. contingency plans for emergencies afloat, including towing mishaps and severe weather;

4. transit preparations, including an appropriate checklist;

5. the expected results of exceeding the design limits for jacking operations; and

6. the minimum wind speeds, sea conditions, and unit motions which would result in instability or structural failure. (Class II, Priority Action) (M-79-39)

"Require self-elevating mobile offshore drilling units to be equipped with a recording fathometer and a recording anemometer. (Class II, Priority Action) (M-79-40)

"Require that critical operating limits for self-elevating mobile offshore drilling units be specified in terms of motion amplitudes and periods, and require on-board motion sensing and recording instruments to determine the actual unit motions. (Class III, Longer Term Action) (M-79-41)

"Study the feasibility of predicting self-elevating mobile offshore drilling unit motions by on-board computer analysis of data from motion sensors and wave measuring instruments. (Class III, Longer Term Action) (M-79-42)

"Expedite the promulgation of regulations for personnel qualifications and manning standards for self-elevating mobile offshore drilling units, and require that industrial personnel who perform seafaring duties obtain appropriate training and licenses. (Class II, Priority Action) (M-79-43)

"Determine and require a functional chain of command on mobile offshore drilling units to effectively cope with extreme situations. (Class II, Priority Action) (M-79-44)

"Develop appropriate survival capsule performance standards, including standards for safe towing. (Class II, Priority Action) (M-79-45)

"Conduct model tests and computer simulations with Whittaker Corporation to determine the survival capsule's capsizing characteristics and behavior in storm seas. (Class II, Priority Action) (M-79-46)

"Require that survival capsules be equipped with accessible towing and mooring fittings, proper fendering, and markings to indicate the location of the towing and mooring points. (Class II, Priority Action) (M-79-47)"

--to the Bethlehem Steel Corporation:

"Equip its future self-elevating mobile offshore drilling units with towing fittings accessible in heavy weather. (Class II, Priority Action) (M-79-48)"

--to the Ocean Drilling and Exploration Company:

"Review and revise the operating manuals for its existing self-elevating mobile offshore drilling units to include guidance regarding:

1. The stability of the unit for the complete range of mat-platform separations;

2. the number of tugs and the horsepower required for towing the unit, and the recommended towing arrangements and equipment;

3. contingency plans for emergencies afloat, including towing mishaps and severe weather;

4. transit preparations, including an appropriate checklist;

5. the expected results of exceeding the design limits for jacking operations; and

6. the minimum wind speeds, sea conditions, and unit motions which would result in instability or structural failure. (Class II, Priority Action) (M-79-49)"

--to the Whittaker Corporation:

"Revise its survival capsule training program to include guidance on towing, securing alongside another vessel, and emergency escape from the capsule. (Class II, Priority Action) (M-79-50)"

--to the International Association of Drilling Contractors:

"Recommend that its members use private meteorological services which provide the special information needed when engaged in weather-sensitive operations. (Class II, Priority Action) (M-79-51)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

April 5, 1979

APPENDIX A

INVESTIGATION

This accident was investigated by a U.S. Coast Guard Marine Board of Investigation. The investigation included a public hearing which convened in New Orleans, Louisiana, on April 21, 1976. Testimony was heard from 41 witnesses, and 152 exhibits were accepted into the record. A representative of the National Transportation Safety Board observed part of the proceedings.

The National Transportation Safety Board has considered all those facts in the investigative record that are pertinent to the Safety Board's statutory responsibility to determine the cause or probable cause of the casualty and to make recommendations.

APPENDIX B

METEOROLOGICAL DATA

Table 1

USS LEXINGTON WEATHER OBSERVATIONS

Day (April, 1976)	Time CST	Wind speed (kns)	Wind & Sea direction (°true)	Sea height (feet)	Swell direction (°true)	Swell height (feet)	Approximate distance (nmi) & direction from OCEAN EXPRESS
13 Tues	1800	18	140	3	nr	nr	55 SSE
	2100	18	140	3	140	3	50 SE
	2400	23	140	nr	nr	nr	40 ESE
14 Wed	0300	19	170	nr	nr	nr	50 E
	0600	22	150	2	150	5	35 NE
	0900	17	160	2	150	5	10 E
	1200	20	160	2	150	5	20 ESE
	1500	17	150	2	150	5	15 N
	1800	28	150	2	150	5	15 S
	2100	27	150	2	150	5	20 S
	2300	29	150	2	150	5	25 SSE
	2400	28	150	nr	nr	nr	15 SE
15 Thurs	0300	19	160	nr	nr	nr	5 NNE
	0600	18	150	2	150	7	20 WNW
	0900	29	140	2	150	7	10 SW
	1200	25	150	2	150	7	20 WSW
	1500	33	160	2	150	8	20 SW
	1800	28	160	5	150	13	20 S
	2100	52*	140	7	140	17	35 E
	2200	52	160	7	140	17	40 E
	2400	42	160	nr	nr	nr	40 ENE

nr = not reported *60-kn peak wind reported

Table 2

NATIONAL WEATHER SERVICE FORECASTS

Day (April, 1976)	Time CST	Wind speed, kns	Sea height, feet	Comments
14 Wednesday	0339	15-20	4-6	S to SE winds, diminishing at night
	0934	15-25	3-6	Winds SE, occasionally gusting to 30, decreasing at night, thundershowers possible
	1539	12-18	3-6 increasing Thursday	Winds SE, increasing to 20-25 on Thursday, decreasing Thursday night, thundershowers possible
15 Thursday	0334	15-25	5-8	Widely scattered showers and thunderstorms today, increasing tonight and Friday
	0934	20-30	5-8	Small craft advisory issued, winds decreasing at night
	1539	15-25	5-8 decreasing Friday	Small craft advisory in effect, winds decreasing at night, thunderstorms possible, Friday SE winds 15-20, decreasing at night
	1745	20-30	6-10 decreasing Friday	Winds gusty, decreasing Friday night, stronger in thunderstorms
	2025	25-35	6-10 decreasing Friday and Saturday	Winds gusting to 50, thundershowers with stronger and variable winds
	2110	28-38	10-15	Gusts to 55, thundershowers possible, gale warning issued

Table 3

PRIVATE METEOROLOGICAL SERVICE FORECASTS

Day (April, 1976)	Time CST	Forecast period	Wind speed (mph)	Significant wave height (feet)	Maximum wave height (feet)	Severe Weather
13 Tues	1400	24-hr	20-30 SSE	2-4 SE	9 random	none
		48-hr	20-30 SSE	6-8 SSE	13 random	
14 Wed	0600	24-hr	10-25 SSE 30-35 gusts	6-9 SSE		isolated thunderstorms by mid afternoon, max gusts 45-50, waves 18-22
		48-hr	10-25 SSE 30-35 gusts	6-9 SSE	14	
	1400	24-hr	10-25 SSE gusts to 35	6-8 S-SE	14	none
		48-hr	12-25 SSE gusts to 35	7-9 SSE	14	
15 Thurs	0600	24-hr	20-30 SSE 35-40 gusts	7-10 SSE	15	isolated thunderstorms by late in 24-hr period, max gusts 45-55, waves 18-22
		48-hr	20-30 SSE 35-45 gusts	8-11 SSE	16	
	1400	24-hr	20-30 SSE gusts to 40	10-13 SSE	18	isolated thunderstorms by early Saturday, max gusts to 60, waves 18-22, random max 25

These forecasts are for Mustang Island Lease Block A95, which is about 30 nmi ENE of block 803 and about 10 nmi S of block A57.