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THE *OCEAN RANGER*

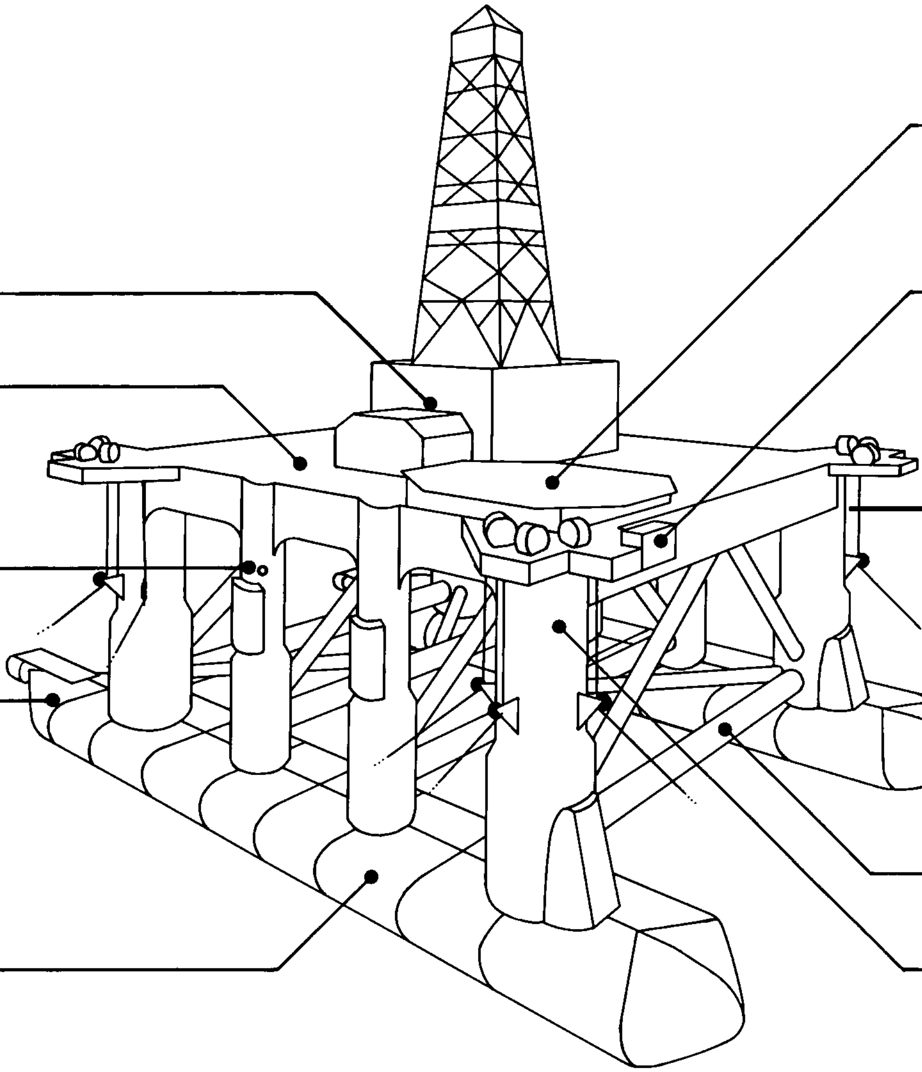
CHAPTER TWO THE OCEAN RANGER

This chapter contains a description of and observations regarding the structure and layout, the ballast and communications systems, and the lifesaving equipment of the *Ocean Ranger*. Those features that are deemed to have contributed directly to the loss of the rig or its crew will be commented upon although greater detail will be provided in subsequent chapters.

The structure of the *Ocean Ranger* was similar to that of many other semisubmersibles operating in Canadian offshore areas and throughout the world. The rig consisted of two pontoons, eight vertical columns, an upper hull with two decks, and a supporting framework of braces and trusses. The two pontoons each contained 16 tanks that served as storage for ballast water, fuel oil and drill water. A pump room and propulsion room were located in the tapered section of the stern of each pontoon. Each pump room contained pumps, piping and valves associated with the pontoon tanks and bilge pumping system. Each propulsion room also contained two electric propulsion motors and their control panels as well as the hydraulic motors and controls for the steering system.

The pontoons were connected to the upper hull by eight watertight vertical columns. A structural framework of horizontal, vertical and diagonal braces connected and supported the upper hull and the port and starboard columns. In addition to giving structural support, greater stability and additional flotation, these columns provided space for equipment and storage, and routing for pipes, ducts and electrical wiring. All of the columns were fitted with ladders and watertight hatches giving access to intermediate decks and compartments. The stern columns each contained an elevator connecting the upper hull to the propulsion and pump rooms.

Each of the four corner columns contained three chain lockers for storage of anchor chains. These lockers lay between watertight flats at the 35-foot and 70-foot elevations. There were two upper deck openings leading into each chain locker; the first with an area of approximately 6 square feet at the top of the chain pipe, and the second with areas varying between 22.4 square feet and 28.3 square feet at the top of the wire box. These two openings were necessitated by the unusual combination of chain and wirerope used in the mooring system. The nature of this system also meant that the chain lockers were empty when the rig was moored at sea. The American Bureau of Shipping designated these openings as the "first point of downflooding", that is, the first point above the waterline where seas could enter the hull if the rig developed a severe trim or list. Nevertheless, there were no coverings provided for these openings, no drainage system in the chain lockers, no means installed for pumping out water and no alarm system to indicate if flooding did take place.



2.1 This illustration outlines the major structural components and working areas of the *Ocean Ranger*. The pontoons, 406 feet long, lay 80 feet below the surface when the rig was drilling.

The *Ocean Ranger* had a twelve-point mooring system with twelve 45,000 pound main anchors. Each anchor was attached to 1650 feet of 3¼-inch link chain, which in turn was connected to 5600 feet of 3½-inch wirerope. Three mooring lines extended from each of the mooring platforms on the four corner columns through fairleads to the anchors. These lines were controlled by winches positioned in groups of three on top of each of the four corner columns at the upper deck level. Control houses on the outboard side of these columns contained the equipment for operating the mooring system, in addition to instrumentation for monitoring anchor line tensions.

The four smaller side columns between the pontoons and the upper hull contained bulk storage tanks for dry drilling mud components. While three of those columns contained two storage tanks each, the third starboard column had only one tank with the space above it occupied by two control rooms. The ballast control room was situated at the 108-foot level above the keel and the control room for the mooring system lay directly above it.

The derrick and drill floor, at the centre of the rig directly over the moonpool, were surrounded by the upper hull which was divided into two major decks and an accommodations area. The lower deck, 134 feet above the keel, contained the primary and emergency electrical generators, air compressors, a machine shop, and

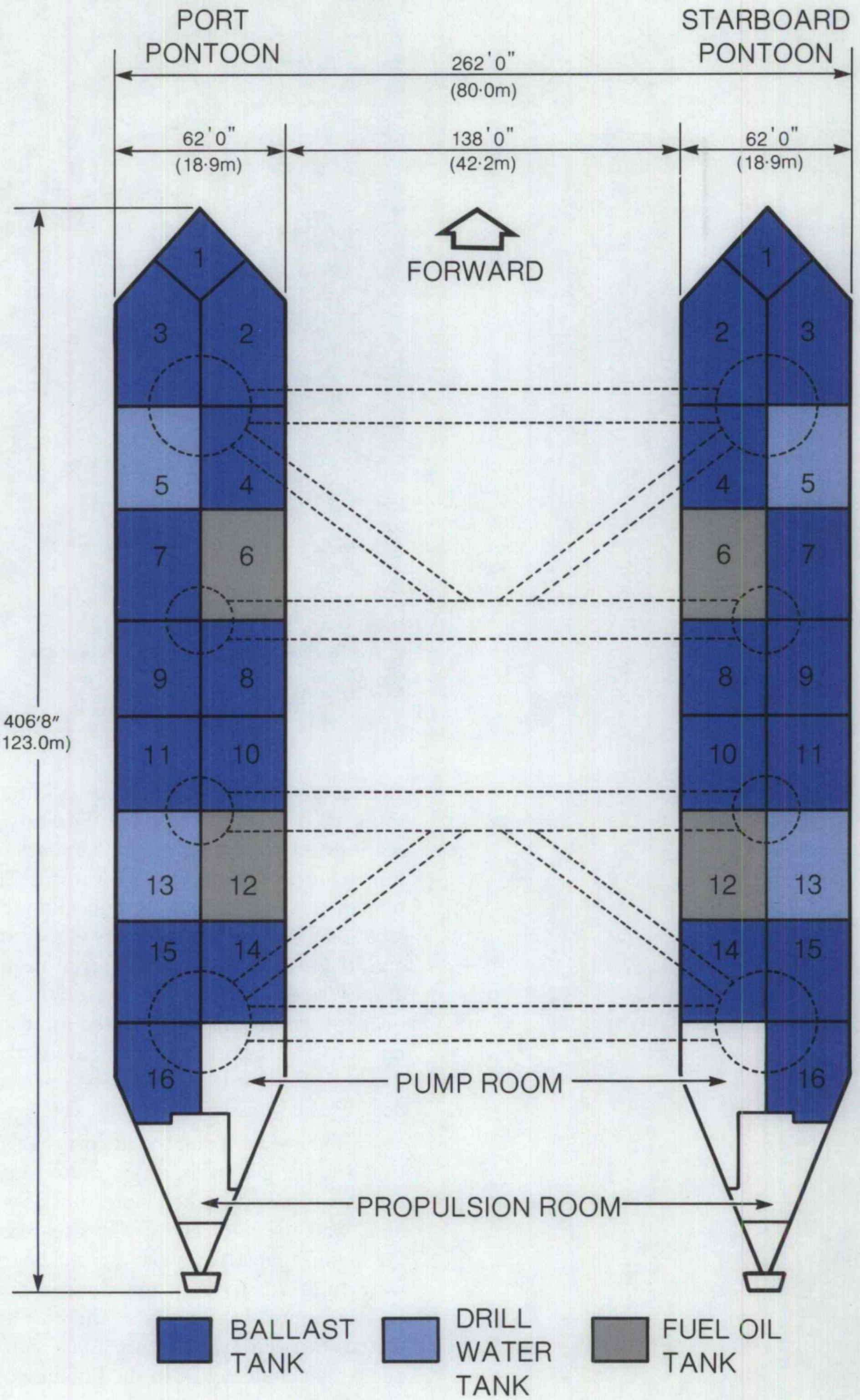
2.2 The *Ocean Ranger's* 12 anchor windlasses were replaced at the shipyard in Port Alberni, British Columbia, during 1979.

storage and handling areas for drilling mud and cement, as well as the first of the three accommodations levels. Two box girders divided the rig transversely into three sections, providing structural support for the drill floor and derrick. They also contained storage tanks for salt water, fuel oil, and drill water. An extensive piping system throughout the upper hull allowed the delivery of these liquids to the required locations. The upper deck served as a storage and handling area for the considerable quantity of supplies and material required to support the drilling operation. Three cranes were used to load material to and from supply boats and to handle it on board. Loading stations located amidships, port and starboard, provided piping connections for the transfer of liquid and bulk cargo. This upper deck, 151 feet above the keel, formed the roof of the lower deck, and the exposed top surface or weather deck of the upper hull.

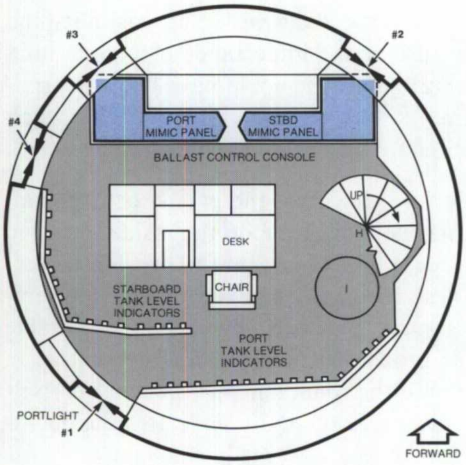
The forward starboard corner of the upper hull provided crew's quarters on the first and second levels, and a radio room, hospital, offices and managers' quarters on the third level. The helicopter deck was located directly above the accommodations area, and the pilot house was situated forward of the accommodations, adjacent to the mooring platform on the starboard bow. The upper deck was designed to be watertight when in an undamaged condition. A severe bow trim, however, would expose several ventilators at the bow and the windows located in front of an unprotected stairwell in the forward port corner of the accommodations area to wave damage which could result in the flooding of the lower deck.

THE BALLAST SYSTEM

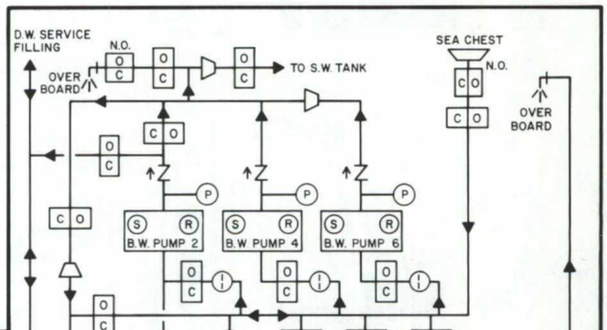
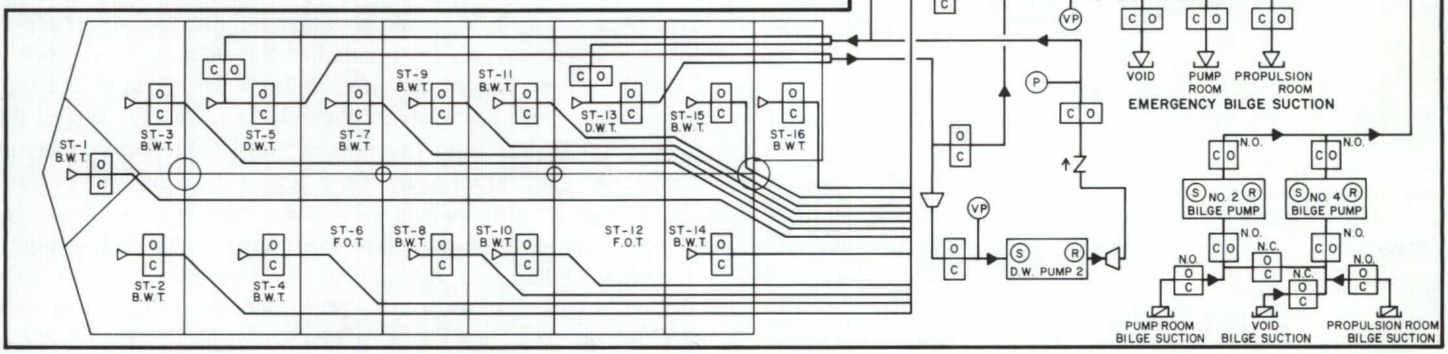
The ballast system on the *Ocean Ranger* consisted of three major components: the 24 ballast tanks in the pontoons; the 6 pumps used for ballast discharge; and the system of pipelines and remotely operated valves connecting the pumps and tanks. Ballast was discharged by opening the appropriate valves from a tank to a pump, and from



2.3 Of the 32 pontoon tanks, 24 were used to store ballast water, with the remainder used to store drill water and fuel oil. The ballast control room was located in the column above starboard tanks 10-13.



the pump to the overboard discharge. When the pump was started, ballast was pumped out of the tank and overboard. In order to take on ballast, the valves leading from the sea chest to a tank were opened, and sea water was allowed to "free flood"[1] into the tank. By discharging or taking on ballast the ballast control operator maintained the rig level at the desired draft.

2.4 The ballast control room, 18 feet in diameter, was approximately 28 feet above the mean water level at the 80-foot drilling draft. The valves and pumps in the ballast system were controlled from the mimic panel, which provided a clearly labelled schematic representation of the system's components. The starboard section of the mimic panel is illustrated.

There is no evidence of serious problems with the ballast system during the rig's six-year operating history. The system worked well when the rig was level; it proved problematic, however, when the rig was trimmed by the bow. At a relatively moderate bow trim the suction limits of the pumps located in the stern of each pontoon were exceeded and the pumps were incapable of discharging ballast from the forward tanks.[2]

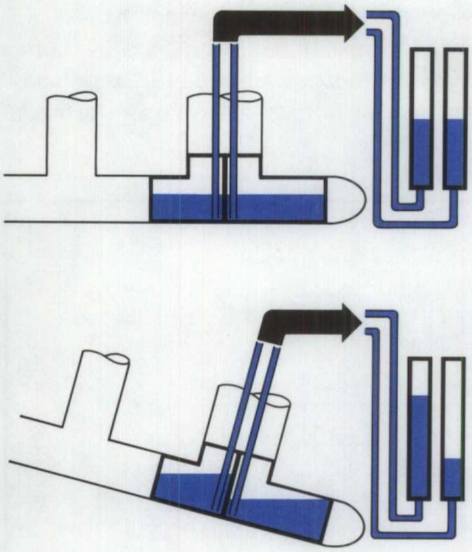
The ballast system was operated from the control room in the third starboard column where the ballast control operators monitored the contents of the pontoon tanks and the stability, attitude and draft of the rig. They used the ballast control console to change the contents of the tanks as necessary and to transfer drill water into or from associated pontoon tanks, adjusting ballast at the same time to compensate for the shifting loads.

The circular ballast control room was fitted with four portholes[3] which allowed the operator to observe the activity of supply vessels during the transfer of cargo and to view the draft marks attached to the four corner columns. Indeed, the primary reason for locating the ballast control room in the column was to permit the ballast control operator to read the draft marks. The farthest of these draft marks was some 200 feet away from the ballast control room. Accurate visual reading of these marks

[1]Many semisubmersible owners follow the practice of pumping water into tanks, as this allows greater control. Free flooding is a very rapid method of filling a tank, and errors in operation can lead to unintentional changes in the rig's attitude.

[2]A more detailed description of the limitations of the system is provided in Chapters 6 and 7, and in Appendix F, Item 4.

[3]For the purposes of this report the term "porthole" refers to the circular frame surrounding a glass window, or "portlight". The ballast control room portlights were fixed in place and could not be opened. More technical information on the portlights will be found in Chapter 6.



2.5 An accurate assessment of the weight carried in each pontoon tank was critical for the stability calculation. Substantial errors would be encountered if the rig was trimmed, as the conversion tables made no allowance for the position of the gauge's sensor tube.

therefore was impossible in bad weather or heavy seas. Even with clear visibility the draft was estimated and subject to error. Because of the importance of maintaining the proper draft, an alternate and a more accurate method should have been incorporated into the rig's design. Remote reading gauges were commercially available when the rig was built and were used on many other contemporary semisubmersibles.

As the ballast control room was considered a dry area, the ballast control console was not protected from sea water. Each porthole did have on the inside a hinged metal cover or deadlight, which could be secured over the portlight to provide protection, but the normal practice was to leave these covers open. Even though the tempered glass was unable to withstand the pressures generated by waves predictable under extreme storm conditions, there was no protection provided for the console in case the portlight did break and sea water entered the room nor was the console itself designed to be watertight. In the event of accidental flooding by sea water the operation of the ballast control system could be affected.

Two sets of tank level gauges or "King gauges" located on the stern bulkhead of the ballast control room indicated the level of sea water ballast, fuel oil and drill water in the pontoon tanks. Conversion tables provided in the *Booklet of Operating Conditions*, were used by the ballast control operators in the calculation of the rig's stability. These conversion tables were accurate only when the rig was level and did not contain corrections to allow for trims to the bow or stern. The location of the King gauges' sensor tubes at the end, rather than at the centre, of each pontoon tank caused changes in the tank level readings when the rig was trimmed to the bow or stern. Therefore, the ballast control operator could misinterpret the tank contents when the rig was trimmed. Furthermore the gauges for the port pontoon were located on the starboard side of the ballast control room and the starboard gauges were on the port side. This confusing arrangement coupled with the possibility of misinterpreted tank contents could lead the operator to take inappropriate countermeasures to right the rig when it was trimmed.

In the centre of the ballast control room were the operator's desk, a video display terminal that showed the position of the rig in relation to the wellhead, and an environmental computer terminal that displayed information on anchor tensions, wind and wave conditions, and rig motions. The operator's desk also held a remote VHF radio and a handset for the public address system that allowed communication with other areas of the rig. In routine operations, the ballast control operator continually monitored two sets of inclinometers[4] which showed the rig's angles of trim and heel up to 15 degrees in each direction. If the angle increased past the desired condition, the operator would use the ballast control console to correct the attitude by discharging or taking on ballast.

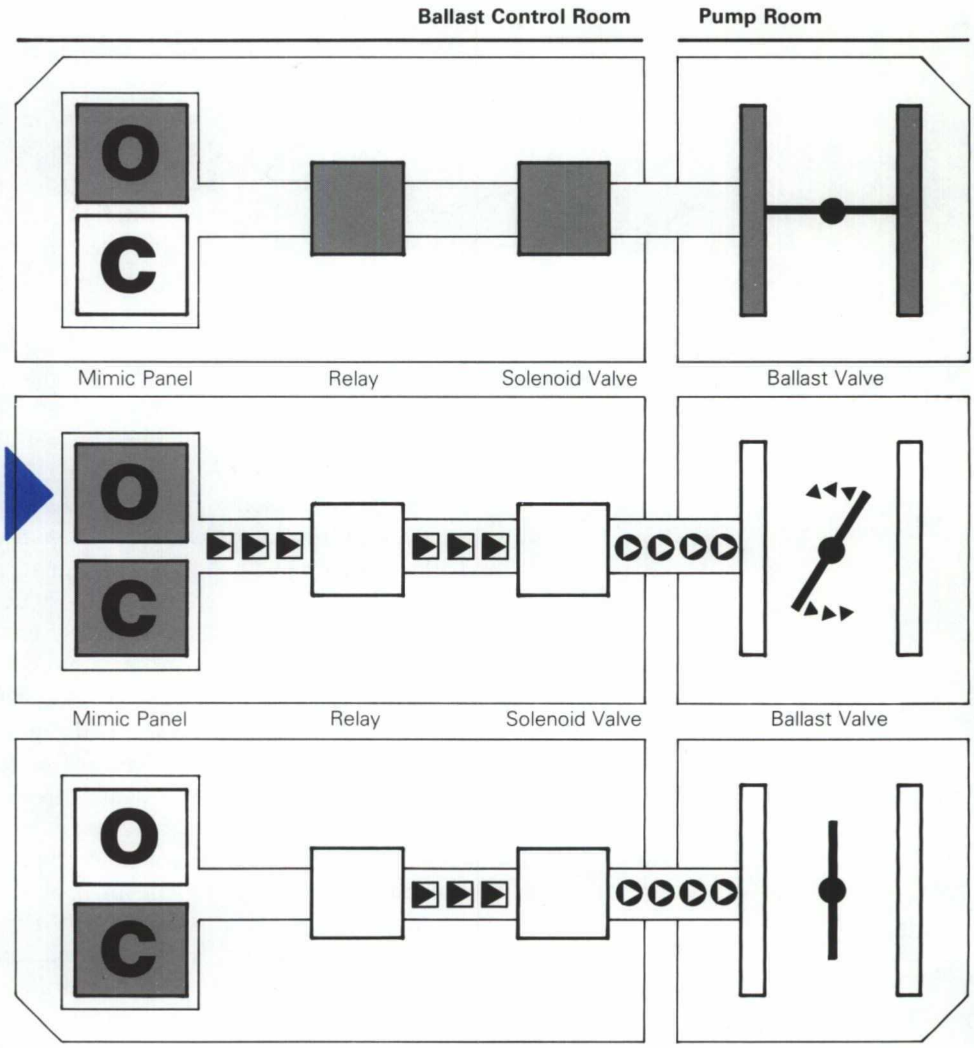
The upper, vertical panel of the ballast control console contained instruments which monitored elements of the ballast, drill water, and fuel oil systems. Additional indicators showed the status (open/closed) of watertight hatches and doors in some of the other columns, and the status of the electrical and compressed air supplies to the control console. The lower, horizontal panel, referred to as the "mimic" panel, was divided into port and starboard sections etched with a schematic diagram representing the tank layout, piping, pumps and valves in each pontoon. Each valve was represented by a red and a green indicator light; red indicated a closed valve, and green indicated an open valve. These indicator lights were set in pairs of push-button switches, labelled "open" and "close", and the valve was operated by pressing the appropriate switch. In a similar manner, the pumps were each represented and operated by red "stop" and green "run" push-button switches containing indicator lights.

[4]Inclinometers were also found in the toolpusher's office, the radio room and the pump room.

VALVE CLOSED. The relay and solenoid valve are both in the unactivated position. A limit switch on the ballast valve actuator, connected to the indicator light through the relay, has illuminated the "closed" light.

OPEN SWITCH PRESSED. The "close" light is immediately extinguished as soon as the relay is activated. The ballast valve is in transit for 20-40 seconds. The failure of the valve to open, or to open completely, results in both indicator lights remaining extinguished.

VALVE OPEN. When the ballast valve is completely open a second limit switch on the valve actuator illuminates the "open" light.



2.6 Ballast control operation using the mimic panel.

Electricity   Compressed Air

The ballast control system was an "electric over air" type, using electric signals from the mimic panel switches to control the flow of compressed air that would open the valves in the pump room. When an "open" switch was pressed, a relay located behind the upper panel was electrically latched into an activated position. As current passed through the activated relay an electrically operated air valve (solenoid valve)[5] underneath the console was opened, and compressed air was directed to a piston and spring actuator on the remotely operated valve. Air entering the actuator caused the piston to move, compressing the spring and opening the valve. To close the valve, the "close" switch was pressed, causing the relay to return to the deactivated position and the solenoid valve to close. This allowed air to vent from the actuator on the remotely operated valve, thus allowing the spring to expand against the piston and close the valve.

The indicator lights on the mimic panel showed only that a valve was completely open or completely closed. When an "open" switch was pressed, the "closed" indicator light (red) was extinguished immediately by the relay, and for the 20-40 second period that the valve was in motion no indicator was lit. When the valve moved to the fully open positon, the "open" indicator (green) was lit. If both indica-

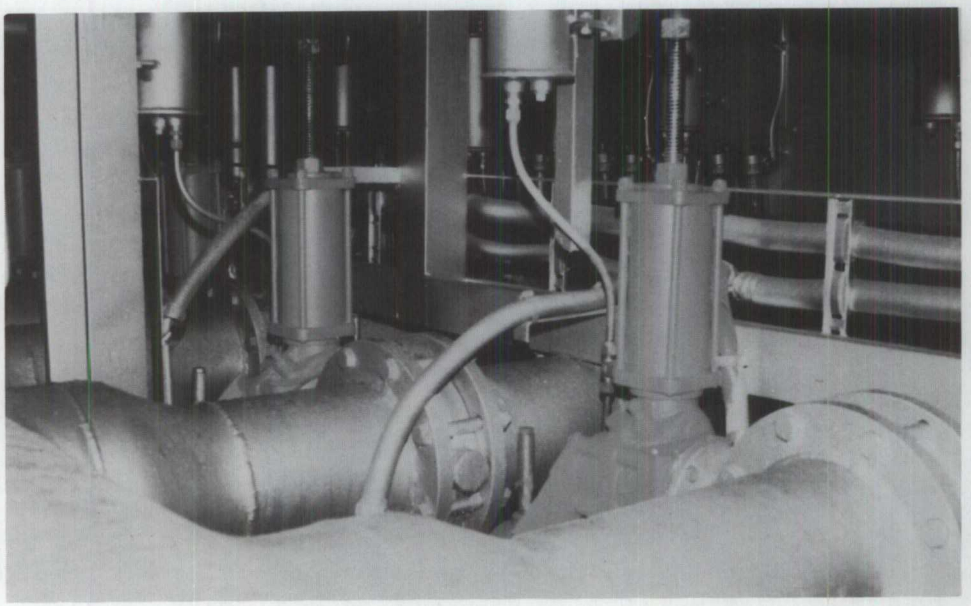
[5]Sixty-four solenoid valves, (one for each of the remotely operated valves in the pump rooms) and their associated wiring and tubing, were located underneath the mimic panel.

tor lights remained extinguished for longer than 20-40 seconds, an *alert* operator would be aware that a malfunction had occurred somewhere in the system, although no alarms were installed to indicate where the malfunction had taken place.

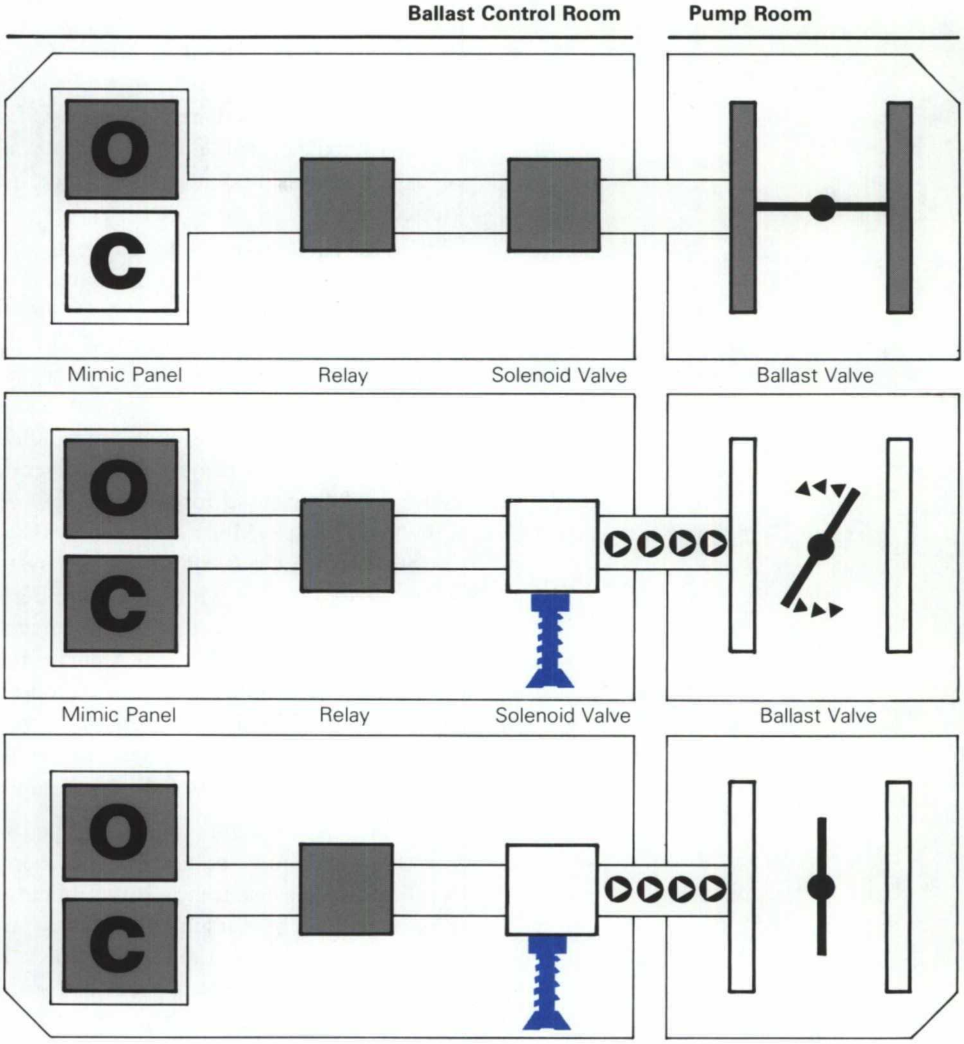
The mimic panel provided very limited information regarding the valves, and no information about the mechanical condition of the equipment. In the event of a mechanical failure in the valve control system, the operator could be presented with confusing or conflicting information. There was no method of ascertaining the direction of travel of the valves from the ballast control room. ODECO's original specifications did require a feature of this type but it was not included in the installed console.

If the supply of electricity or compressed air to the control console was lost, all remotely operated valves closed automatically. This "fail-safe" feature ensured that the valves would never be left open unintentionally if a power failure should occur. If power should be lost at the mimic panel, the ballast valves and pumps could be operated manually from the pump rooms. Each ballast valve could be opened or closed by turning a jackscrew on the valve itself. In each pump room, switches were provided to control the operation of the pumps. A manual ballasting operation using this method would have had to be co-ordinated from the ballast control room as the King gauges there were the only means available for determining the contents of the ballast tanks. As the public address system was the only method of communication available to the pump rooms, a failure in that system would have made manual ballast control operations from the pump rooms difficult.

ODECO ought to have realized the importance of providing a method of manually controlling the ballast valves from the ballast control room and incorporated this requirement in its contract specifications. It so happened that the resident electrician, representing the owners during the construction of the rig, knew that this could be done using the solenoid valves. The solenoid valves could be opened by inserting any device, the size of a pencil. By withdrawing the device the solenoid valve would close. He arranged for Mitsubishi to fabricate brass rods for this purpose which he used to test the pneumatic system before the electric control panel was installed. He also arranged for the brass rods to be stored in a box behind one of the panels of the control console. But there were no diagrams or instructions regarding the use of this method of manually controlling the valves from the ballast control room.



2.7 This photograph shows two of the remotely operated 18-inch butterfly valves in the pump room, which connected each ballast tank to the common manifold. Two other valves can be seen in the background, and the manifold is visible in the lower left-hand corner. These valves could be operated manually by using the threaded jackscrew at the top of the actuator.

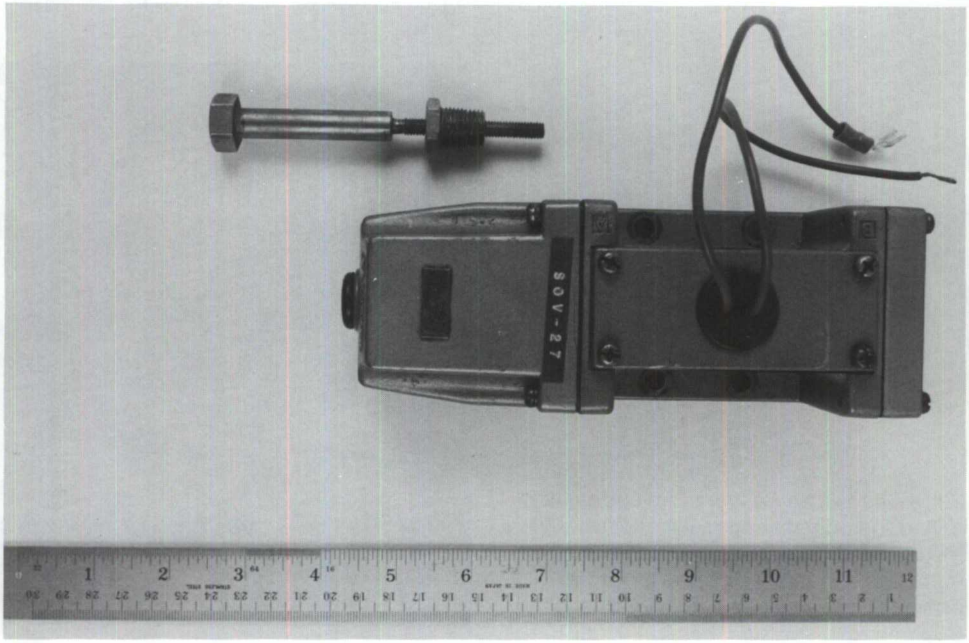


VALVE CLOSED. The relay and solenoid valve are both in the unactivated position. A limit switch on the ballast valve actuator, connected to the indicator light through the relay, has illuminated the "closed" light.

BRASS ROD INSERTED. The solenoid valve is manually activated, causing the ballast valve to open within 20-40 seconds. As the valve starts to move and releases the limit switch, the "close" light is extinguished.

VALVE OPEN. With the ballast valve fully opened, the 'open' light remains extinguished because the relay is in the unactivated position. Opening the ballast valve in this manner does not require electrical power to the mimic panel.

2.8 Ballast control operation using the brass rods.



2.9 The solenoid valve on the right is one of the 64 recovered from the wreck. The black protrusion at the front of the valve is a plastic dust cover inserted in a threaded opening. Although the valve was normally opened electrically using the switches on the mimic panel, it could also be opened manually by pushing the solenoid core with a tool inserted through this hole. The brass rod at the top is one of at least eighteen that were placed in the ballast control room, during construction, for this purpose.

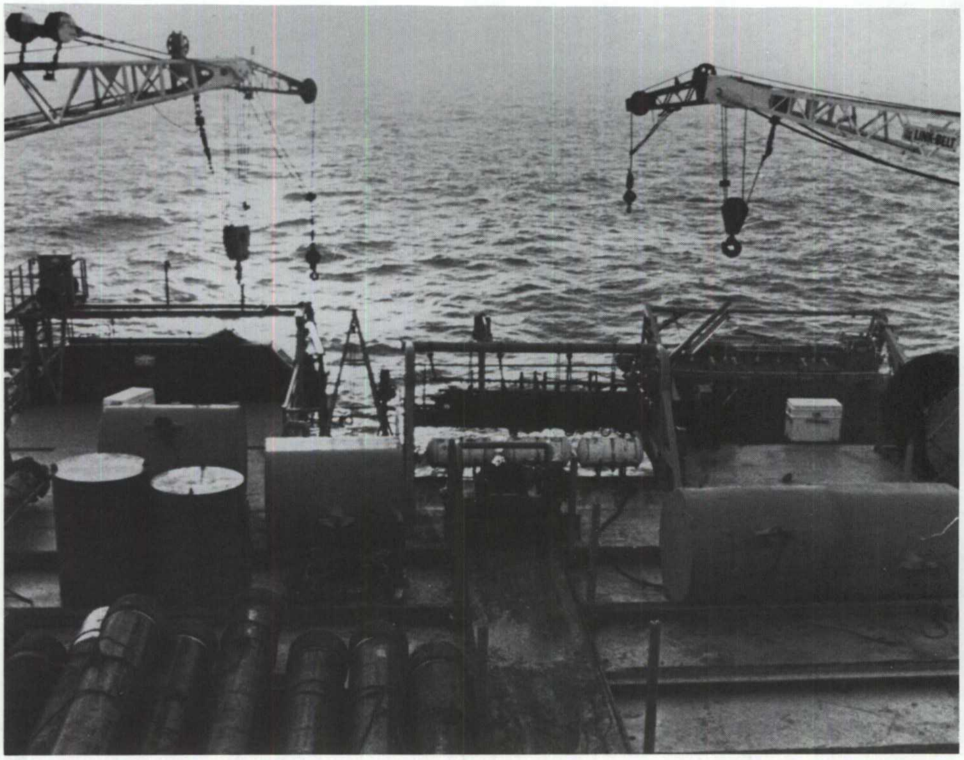
COMMUNICATIONS SYSTEMS

All drilling rigs engaged in offshore exploration maintain contact with shore bases, supply vessels, and other rigs while carrying out the drilling operation. The *Ocean Ranger* was equipped with a variety of systems for both external and internal communications. Several separate radio systems permitted the transmission and receipt of external communications by voice, telex, telegraph, and facsimile (Appendix D, Item 3).

The radio room, located on the third level of the accommodation area, contained the main HF radio unit, a marine VHF set, an aviation band VHF set, a wireless telegraphy system, and an automatic watchkeeping receiver for the 2182 kHz International Distress Frequency. The radio room was manned on a 24-hour basis by two ODECO-employed radio operators. Both Mobil and ODECO installed additional communications equipment to assist their personnel in conducting routine operations. Mobil installed a single side-band HF radio, with telex capability, in the radio room, and a remote transceiver in the Mobil drilling foreman's office. This radio was used by Mobil personnel to communicate with their shore base in St. John's and with Mobil personnel assigned to other rigs in the area. Mobil also installed two radio communications systems in its drilling foreman's office: a SPECTOR system and a Maritime Satellite (MARISAT) communications system. The SPECTOR system was an error-correcting device for telex transmissions and was capable of encoding data for security purposes. The MARISAT system provided an instantaneous satellite communication link (telephone, telex, and facsimile) from the rig to the worldwide commercial telephone and telex services. ODECO installed a single-side band HF radio set, similar to Mobil's, in the toolpusher's office to allow direct communication to ODECO's shore base in St. John's.

The *Ocean Ranger* was equipped with VHF radios in various locations, including the pilot house, ballast control room, cranes and the toolpusher's office. Marine VHF sets were used as a communication link with supply vessels. Handheld VHF sets were used by personnel on the rig to communicate with each other and with the supply vessels during the loading and offloading of cargo. A combined public address and intercom system was used for communicating on board the rig and for sounding the fire and abandon rig alarms. A sound powered telephone system, connecting many critical areas, was available as a back-up to the public address system. Surprisingly, no sound powered telephone was installed in the ballast control room.

2.10 The *Ocean Ranger's* radio room contained the primary communications equipment, installed in this console. The two inclinometers in the corner of the room were similar to those installed in the ballast control room and several other locations.



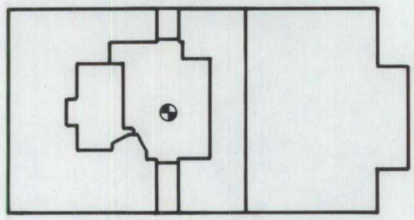
2.11 The stern of the *Ocean Ranger* showing the Harding (right) and Watercraft (left) lifeboats. A life raft station with three raft cannisters and a scramble net is located between the two boats. The white boxes beside each boat contained life preservers.

LIFESAVING EQUIPMENT

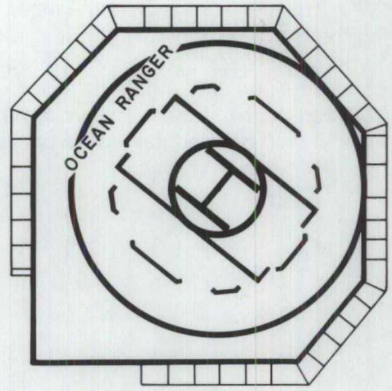
The primary lifesaving equipment included four totally enclosed fibreglass lifeboats, ten inflatable life rafts, 127 adult life preservers with lights and retro-reflective tape, 25 buoyant work vests, 15 life rings with lines, and an emergency position-indicating radio beacon (Appendix F, Item 6). When the *Ocean Ranger* was issued the *Certificate of Inspection* in 1979, the U.S. Coast Guard directed ODECO to ensure that the lifesaving equipment met their standards by replacing existing lifeboats and davits with U.S. Coast Guard approved equipment and by installing for 100% of the rig's crew davit-launched life rafts or an acceptable substitute. This directive was to be completed before the next inspection scheduled to take place on December 27, 1981. To comply with the second of these directives ODECO opted to install two additional 58-person lifeboats rather than davit-launched life rafts. At the time of the loss, however, although one of the new lifeboats was installed, it is not known whether it was provisioned and fully operable, and the other was stored on deck awaiting installation. ODECO had not replaced or changed the existing lifeboats and davits to comply with U.S. Coast Guard requirements (Appendix C, Item 5).

Lifeboats #1 and #2, built in Norway by Harding A/S, were located on the upper deck at the port bow and stern. Each had a 50-person capacity and was self-righting, in that it returned to an upright position if capsized, provided all personnel inside were secured by seatbelts and there was no damage and no significant accumulation of water inside. These boats were fitted with an "off-load" release mechanism which prevented the lifeboats from being released until they were waterborne. The Harding lifeboats were approved by Norwegian regulatory bodies. That these lifeboats were not approved by the U.S. Coast Guard does not mean that they were inherently unsafe or unfit for use during an evacuation, but merely that they were not manufactured according to procedures required by the U.S. Coast Guard. To receive U.S. Coast Guard approval a manufacturer is required to submit the design plans of the lifeboat for approval, after which the lifeboat has to be manufactured under the supervision of the U.S. Coast Guard.

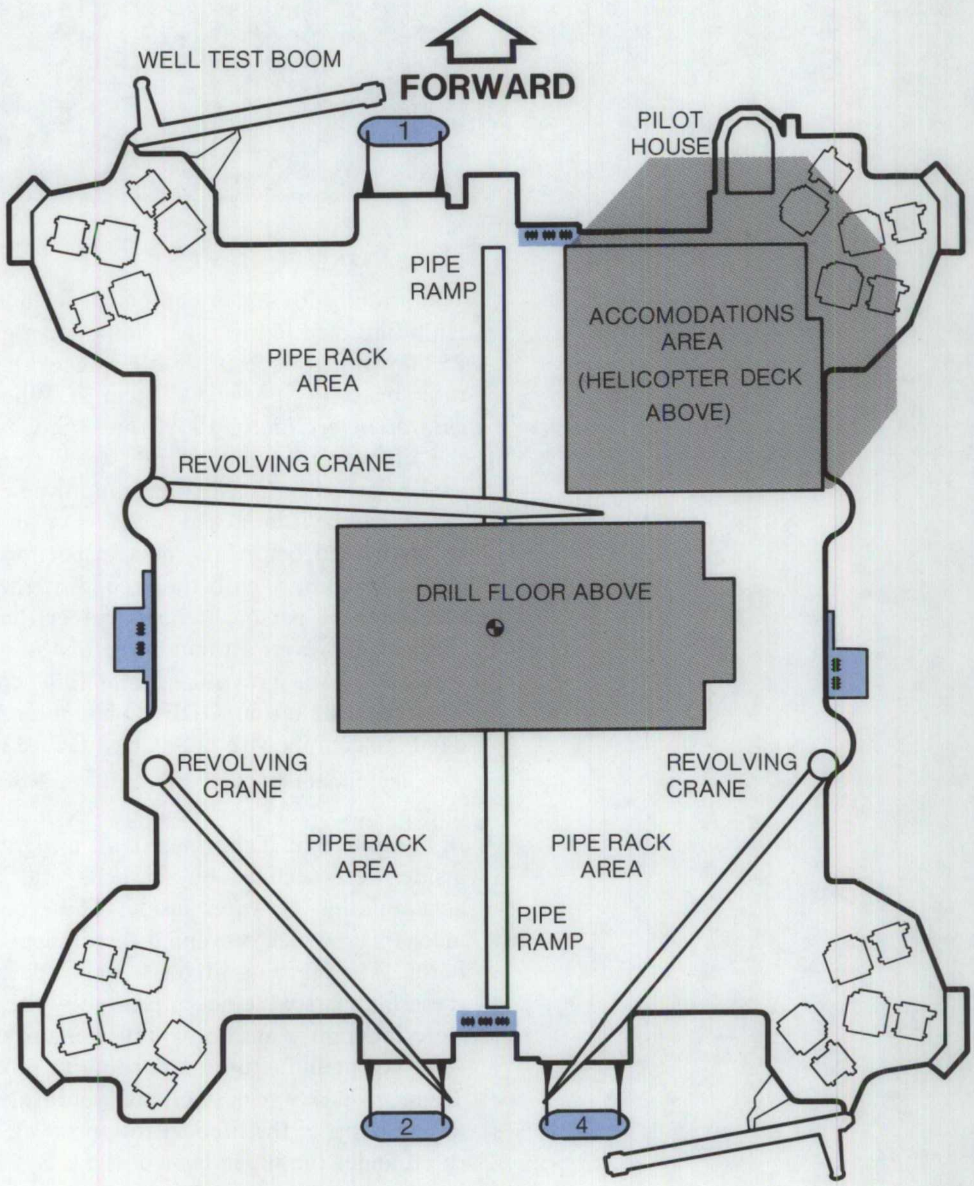
2.12 The upper deck was the main working area. Drill pipe and casing were loaded by crane from supply vessels, and stored in racks at the bow and stern. As drilling progressed, this material was moved to the drill floor along the pipe ramps and subsequently lowered into the well. The well test booms located at the port bow and starboard stern were used to flare gas and burn oil from the well during testing. At the time of the loss three lifeboats and ten life rafts were installed on this level; a fourth lifeboat was stowed on deck awaiting installation. Lifeboats #1 and #2 were 50-person Harding boats, while #4 was a 58-person Watercraft.



PLAN OF DRILL FLOOR



HELICOPTER DECK



2.13 One of the Billy Pugh Model #200 life preservers recovered. The sea water-activated light that was attached to each life preserver is missing from the photograph.

The additional lifeboats were being installed at the time of the casualty. Lifeboat #3 was stowed on the upper deck awaiting installation and lifeboat #4 was installed on the starboard aft section of the upper deck awaiting inspection. These fibreglass lifeboats were manufactured by Watercraft America Incorporated of Edgewater, Florida. They were approved by the U.S. Coast Guard and were designed to be self-righting. The Watercraft boats were fitted with an "on-load" release gear which allowed release at any time during the launching sequence. The rig's muster list had not been altered to reflect the addition of one more lifeboat. It is not known whether the crew received instruction in the operation of the Watercraft lifeboats. Lack of proper instruction could cause confusion during an evacuation, since the release mechanism on the Watercraft lifeboats differed from that on the Harding lifeboats.

The ten, 20-person life rafts were positioned on the upper deck: four on the stern, two on the bow, and two on each side. All were manufactured in the United States. They were equipped with manual and hydrostatic release mechanisms and could only be entered from the water. These life rafts were inspected by IMP Group Limited (St. John's) in 1981. IMP was not a U.S. Coast Guard approved service centre for life rafts, nor was there an approved centre in Eastern Canada. (The nearest was in Boston, Massachusetts.) Minor deficiencies were found during this inspection and the life rafts were repaired before being returned to the rig. There was no evidence to indicate that these life rafts were used during the evacuation.

The method of deploying the life rafts from the rig required them to be thrown overboard and entered from the water. To get to the life raft the crew would have to climb down scramble nets located at each life raft station. In calm water and light wind this mode of escape may be practical; during storms life rafts deployed in this manner are generally impractical since high winds will blow an unoccupied raft away from the rig. Davit-launched life rafts would have been more useful as a means of escape. These life rafts, with crew members inside, are deployed in the same manner as lifeboats.

There were 127 Billy Pugh Model #200 life preservers which had been labelled as approved by the U.S. Coast Guard and 25 Billy Pugh Model WV0-100 work vests on board. The life preservers and work vests were positioned at various stations on the deck and in the crew's quarters. An unknown number of the life preservers was not, in fact, approved by the U.S. Coast Guard. These life preservers were sold by the manufacturer without receiving final approval.

As specified by COGLA, there were two types of immersion suits on board; insulated coveralls for crew members working in exposed areas of the rig and another type for use on helicopter flights to and from the rig. These immersion suits were not designed to offer protection against cold water and hypothermia. There were no regulatory requirements for marine evacuation suits (survival suits) although COGLA had previously suggested that all rigs and support vessels be equipped with survival suits. On July 7, 1981, some eight months before the loss of the *Ocean Ranger*, COGLA telexed all offshore operators stating that the loss of the *Arctic Explorer* and 13 of its crew members off northern Newfoundland highlighted the necessity of having survival suits on board and suggesting that they be provided (Appendix C, Item 6). But, as of February 1982, little progress had been made in carrying out this suggestion.

3

MANNING

CHAPTER THREE MANNING

Mobil Oil Canada Ltd. (Mobil), the operator for the consortium on the Hibernia Field, co-ordinated all aspects of its exploratory drilling program off the east coast of Canada from offices in St. John's, Newfoundland. These activities were the responsibility of the east coast manager. To carry out its drilling program, Mobil negotiated contracts with other companies for equipment and supplies such as drilling mud, cement and casing; services such as sea and air transportation to and from shore; and specially trained personnel such as divers, geologists and technicians. The largest contracts were with drilling contractors for rigs and their crews. In February 1980, Mobil entered into a contract with ODECO Drilling of Canada Ltd., a drilling contractor, for the *Ocean Ranger* and ODECO set up an office and a shore base in St. John's.

KEY PERSONNEL

The drilling operations and in fact all operations on the rig and even the rig itself, were under the control of the toolpusher, the senior ODECO man on the rig. All of the crew, except Mobil personnel and Mobil-contracted personnel, reported directly or indirectly to him. The toolpusher was appointed to his position of command after obtaining considerable experience in drilling operations. His training was on the job, learning by doing, supplemented with specialized short courses provided by his company, the industry or a training institution. The toolpusher on the *Ocean Ranger* on the night of the loss was Kent Thompson, a United States citizen, who had 15 years of drilling experience and had completed courses on blowout prevention, well control and rig management.

Closely associated with the toolpusher in his control of the drilling function was Mobil's drilling foreman; at least one was always on the rig. His responsibility was to represent Mobil's interests by monitoring the operations to ensure that the drilling program was completed as expeditiously and economically as possible. Possessing the authority to issue instructions to the toolpusher on drilling and industrial matters, he held considerable influence on the rig. The senior Mobil drilling foreman at the time of the loss was Jack Jacobsen, a Canadian citizen, with 16 years drilling experience. He had been an assistant superintendent with SEDCO for seven years before joining Mobil in 1980 as a drilling foreman. His training had been on the job, supplemented with courses in blowout prevention and applied drilling techniques.

The toolpusher's immediate subordinate in the drilling crew was the driller. He was the overall supervisor of operations on the drill floor and from a console located there he operated the drilling machinery and directed the activities of his crew which included a derrickman, several floormen, and a number of roustabouts. The derrickman was responsible for maintaining and repairing the equipment required to circulate the drilling fluid and the floormen were responsible for connecting the sections of drill pipe together to be run in and out of the well. In addition to helping with the drilling operation, roustabouts were required to conduct regular maintenance duties and assist the crane operator and the master during loading operations or when general marine maintenance was required.

Part 10.05-4(a) "The minimum service and experience required to qualify as applicant for license as a master of ocean mobile offshore drilling units . . . is (1) Four years' service as a roustabout, helper, roughneck, roustabout pusher, derrickman, crane operator, deck watchstander or the equivalent . . . Up to two of the . . . four years . . . service shall have been in a supervisory capacity . . . while so employed in such supervisory capacity an applicant must have performed all of such duties as . . . scheduling helicopter and boat deliveries and communications . . . directing operations of the unit, calculating and maintaining stability, exercise responsiblity for . . . maintenance of lifesaving and fire fighting equipment, maintenance of the unit in compliance with applicable government and company regulations . . . ."

U.S. Coast Guard Code of Federal Regulations 46 CFR

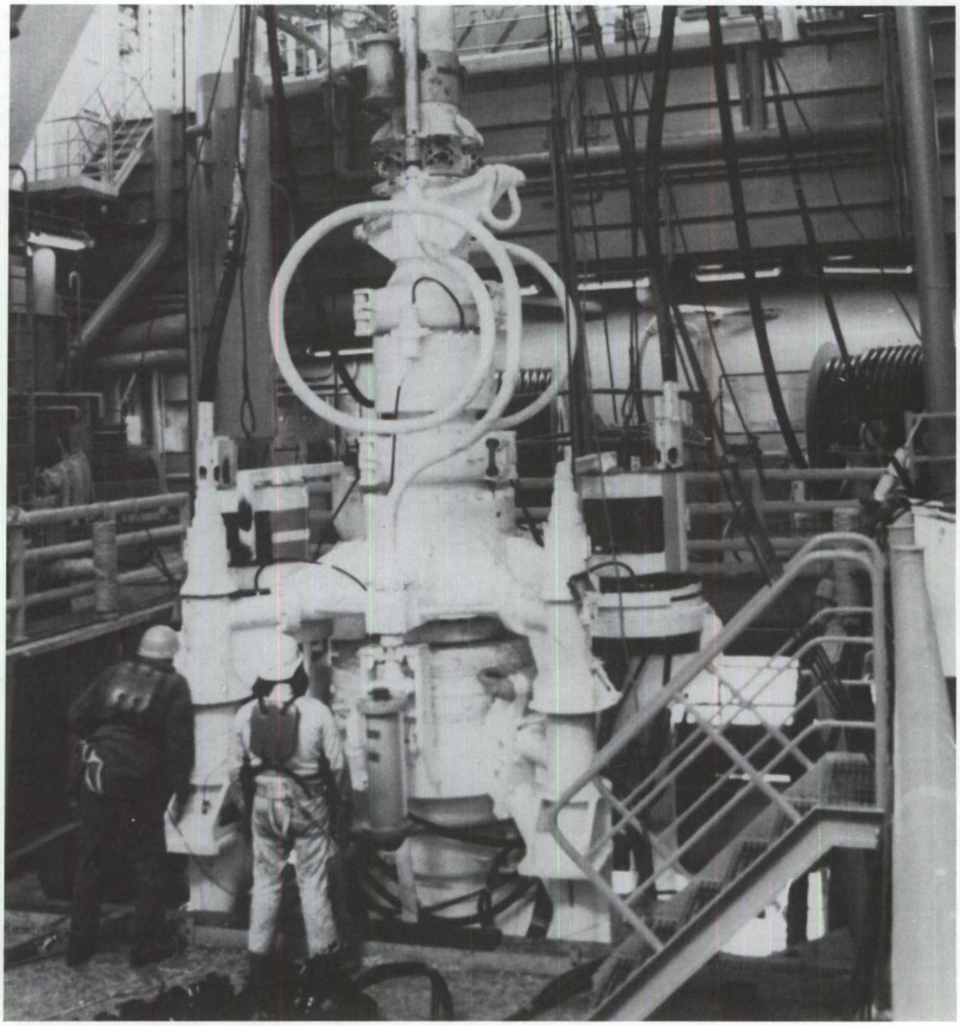
The master co-ordinated the marine aspects of the operations while the rig was moored on location. In order of seeming importance the master ranked third behind the toolpusher and the drilling foreman. He was not in command. He was responsible for the supervising and training of ballast control operators, for the loading of deck cargo, for the general marine maintenance of the rig and marine equipment and for the marine safety training of the crew. The master on board when the rig was lost was Captain Clarence Hauss, a United States citizen, who was assigned to the *Ocean Ranger* on a temporary basis on January 26, 1982, just 19 days before the casualty. He held a Master's licence (Unlimited, OCEANS) and for 15 years had been employed by Bethlehem Steel Corporation as a master and mate. When he joined ODECO in 1981, he was assigned to the *Ocean Victory* and the *Ocean Bounty* before joining the *Ocean Ranger*. During the 10 years prior to joining ODECO, he was not active as a mariner, but had worked as a stevedoring superintendent, as a technician in a detoxification centre and as a salesman.

Other members of the crew employed by ODECO performed dual functions which supported the rig both as a marine structure and as an industrial installation. They were the ballast control operators, electrical and mechanical personnel, crane operators, radio operators, the safety engineer[1] and the medic. The electrical and mechanical personnel and the ballast control operators played key roles in the sequence of events that led to the loss of the rig.

The electrical and mechanical systems were maintained by two electricians, an electronics technician, two motormen and two mechanics. They were responsible for conducting maintenance on the main engines, the emergency generators, the pumping and piping systems and the electrical and electronic equipment. They shared responsibility for the maintenance of the ballast control system but there was no single person on the rig who fully understood the function and operation of the entire system. The electricians were responsible for the maintenance of all electrical systems, the main generators, the emergency generators and all electrical aspects of the several control panels. They were required to check the ballast control console at least every 21 days to ensure that all lights, pump switches and solenoid valves were functioning properly. The senior electrician on board on February 15 was Thomas Donlon, a United States citizen, who had extensive experience as an electrician and had been on the *Ocean Ranger* since 1977. The junior electrician on board was Paul Bursey, a Newfoundlander, who had been employed for seven years as a marine electrician with Canadian National before joining ODECO and the *Ocean Ranger* in June 1981. The electronics technician was responsible for the public address system, the gas detection and fire alarm systems and the communications equipment. He would also assist the electricians whenever necessary. The electronics technician on board was Ted Stapleton, a Newfoundlander who had 15 years onshore experience before being employed by ODECO in 1981.

The rig mechanics were responsible for maintaining the mechanical systems, including the main engines and the valve actuators in the pumping system. The senior rig mechanic on board was George Gandy, a United States citizen, who had extensive experience in the drilling industry in the Gulf of Mexico, the North Sea and off West Africa. He joined ODECO in 1977 and was assigned to the *Ocean Ranger* on a regular basis in March 1980. He held an Ordinary Seaman's ticket issued by the U.S. Coast Guard.

[1]This person is also referred to as the industrial relations representative.



3.1 This photograph shows the blowout preventer and marine riser being lowered to the seabed through the moonpool in the cellar deck. The blowout preventer is below the level of the deck, and the lower marine riser package and the riser connector are at the level of the two crew members in the foreground.

3.2 A welder at work on the slip joint, which is the primary element of the heave compensation system, and the point at which the marine riser connects to the rig. The worker is wearing a work vest and is secured by a safety belt and line.

The ballast control operators were responsible for the operation of the ballast system. There were two on board the *Ocean Ranger*, each working a twelve-hour shift changing at noon and midnight. They were usually, but not always, relieved by the master during brief absences for meals and for routine inspections of the pump room or the deck. The role of the ballast control operators will be examined from several perspectives in different sections of the report. It is sufficient here to review their key function which was to maintain the stability, trim and draft of the rig and change its attitude by adding or removing ballast, as required by the drilling crew. They also monitored the tension on the 12 anchor lines.

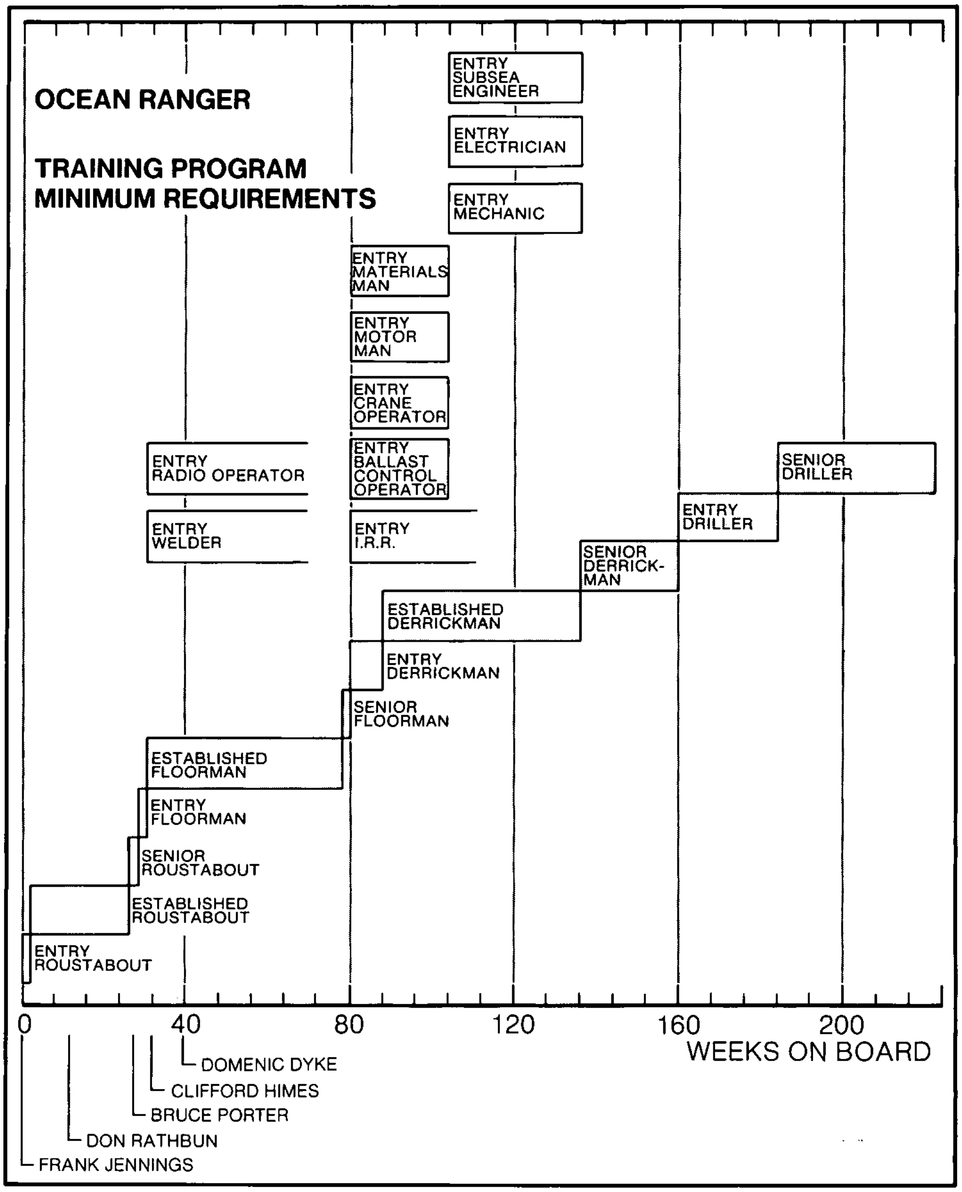
The senior ballast control operator on the night of the loss was Donald Rathbun, a United States citizen, who joined ODECO as a roustabout in January 1980 with no previous drilling or marine experience. In March of that year he became a ballast control operator, learning through on-the-job training and private study. He had no formal training in his functions or responsibilities in the ballast control room. The junior and night ballast control operator was Domenic Dyke, a Newfoundlander, who before joining ODECO as a roustabout in December 1980, had worked with Crosbie Offshore Services as a deckhand on a supply vessel and with SEDCO as a roustabout. He was promoted to ballast control operator on December 31, 1981. He too learnt his functions and responsibilities through on-the-job experience and private study. He had several years of university education but received no formal training in ballast control operations. (Appendix D, Item 2 contains additional information regarding key personnel.)

ODECO TRAINING PROGRAM

The training policy and practice of ODECO reflected the general approach of drilling contractors in the oil industry; it emphasized on-the-job training, supplemented later with in-house courses for specific industrial duties. This policy was based on the conviction that it was advantageous to have inexperienced employees learn the required skills "from the bottom up." In this way they would understand "the company's way" of doing things and those with promise could be selected for appropriate training. The company could be confident that each employee had a minimum level of expertise required for the job and would have greater flexibility for transfers within the company. An inexperienced individual was hired as a roustabout, the general labourer in the oil industry. Through training on the job he could become familiar with the various activities on the drill floor and the general operation of the rig. In time and with experience he could be promoted to floorman and eventually to more senior positions, even to that of driller or toolpusher. In the course of this advancement he would, if selected, be provided with short courses in well control, blowout prevention, management and other related matters.

ODECO generally selected its ballast control operators from the drilling crew. If an individual showed the necessary interest and potential, he could train to become a ballast control operator. The stated training program of ODECO permitted a roustabout to train as a ballast control operator after 80 weeks' experience on the rig. After 24 weeks' training he could be placed in charge of the ballast control room. In practice, however, ODECO did not follow this policy. Three former ballast control operators gave evidence at the public hearings (Frank Jennings, Cliff Himes, Bruce Porter). Jennings testified that he responded to a newspaper advertisement and was appointed as a ballast control operator without any drilling or marine experience. After only several days of orientation he stood a normal 12-hour watch by himself in the ballast control room. Himes had 28 weeks, Porter had 32 weeks, Rathbun had 12 weeks, and Dyke had 40 weeks of roustabout experience before being appointed to the ballast control room.

3.3 The ODECO training policy for the industrial crew required 80 weeks of experience before a crew member was recruited to train as a ballast control operator. This policy was not followed on the *Ocean Ranger*.



It is apparent that in practice the training of ballast control operators was at variance with ODECO's stated training program. The actual practice was to identify prospective candidates by the interest they expressed in training for the position. After he had completed his 12-hour shift the prospective candidate would be permitted to spend time in the ballast control room. No provision was generally made for him to work regular shifts as an understudy. When he had demonstrated to the experienced ballast control operator and to the master that he had the necessary skills and understanding to operate the mimic panel and to complete the daily calculations and the stability log, his appointment as a full-time ballast control operator would be recommended to the toolpusher. He would have had no courses nor would he have to pass tests, formal or informal, to determine whether he understood the system. The only requirements were an elementary understanding of how the system operated, the mechanical skill to operate the system through the use of the mimic panel, and the ability to make simple stability calculations. The training program did not provide an understanding of the electrical and mechanical operations of the ballast control system nor the effects of ballast gravitation. A thorough knowledge and understanding of what might go wrong and how to detect and remedy the situation were also lacking. The training emphasis was based on the erroneous assumption that the ballast system was fail-safe.

As mentioned in Chapter 2, there existed in the ballast control room, in a box behind one of the panels, brass rods which could be used to operate the ballast valves from the ballast control room without using the mimic panel. Why the existence of these rods was not more widely known, and why personnel were not instructed in their use has not been fully determined. Jennings, a former ballast control operator who served for some five and one-half years on the *Ocean Ranger* had no knowledge of their existence, let alone their purpose. During preliminary interviews conducted just after the loss, Himes, who was trained by him, had no knowledge of how the manual control system operated. Porter, who became a ballast control operator two months before the loss of the rig, testified that Rathbun told him that if a valve malfunctioned it could be operated from the ballast control room with the insertion of a manual control rod into the appropriate solenoid valve, located underneath the mimic panel. Porter produced a notebook compiled during his training period, to confirm that Rathbun's explanation was that when the rod was inserted, the malfunctioning valve would close. In fact, it would open. As 18 of these manual control rods were inserted on the night of the loss, this misunderstanding may have had serious implications. Had the ballast control operators understood the ballast control system, or had information about the manual control method been included in the *Booklet of Operating Conditions*, in a separate manual describing the console, or even in a drawing showing the details of the solenoid valves, the operators would have known how to operate the valves manually from the ballast control room.

"Should a valve become stuck open, you can close it manually by using the screw-wrench on far right side under console. Pull out black rubber plug in the offending valve (and) screw in valve."

Entry from Bruce Porter's notebook, Exhibit #136

During the period 1975 to 1978 ODECO provided formal training through a short three-day course in elementary stability theory for its ballast control operators, masters and barge engineers. The intention was to have all employees responsible for ballast control take this course. ODECO did not formally test course participants as job performance was seen as the real test of their understanding and knowledge. The ballast control operators on board at the time of the loss did not have the opportunity to take this course because it was no longer offered by ODECO when they were appointed to this position.

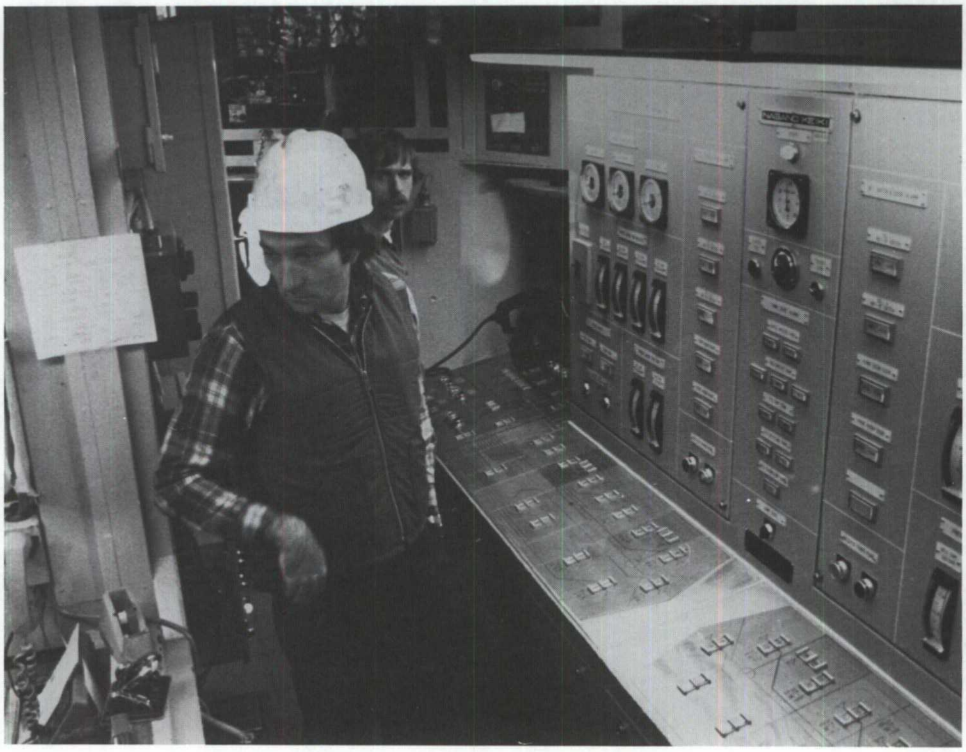
The U.S. Coast Guard, COGLA and the Petroleum Directorate did not specify in regulations or in guidelines the minimum training to be required of a ballast control operator. COGLA's regulations expressed in general terms that "they receive instruction and training in all operational and safety procedures that [they] may be required to carry out." COGLA did not have specific standards drawn up nor did it have any means of verifying the competence of ballast control trainees or of their instructors. In fact, neither COGLA nor the Petroleum Directorate appear to have taken much interest in the instruction or training of the crew.

Section 150. (1) "Every operator shall ensure that every person employed on a drilling program (a) receives instruction and training in respect of all operational and safety procedures that person may be required to carry out during the course of his duties during employment. . . ."

Canada Oil and Gas Drilling Regulations, November 1980

ODECO HIRING POLICY

In October 1980 ODECO submitted its proposed hiring and training program for the *Ocean Ranger* to the Government of Newfoundland. ODECO planned to hire 20 local residents as entry level floormen, radio operators and welders within 34 weeks, and then to replace 50% of the remaining crew with local residents thus filling approximately 60% of the total crew complement. After 104 weeks this percentage would be increased to 74% with local residents filling positions at the entry level of derrickman, ballast control operator, crane operator, motorman, materialsman and industrial relations representative (safety engineer). Within 182 weeks ODECO felt that 92% of its crew would be local residents through the addition of electricians,



3.4 Ballast control operators at work in the ballast control room. The photograph shows the confined working area in the room; an Aldis lamp, used for illuminating the draft marks at night, can be seen on the port section of the mimic panel in front of porthole #3. The handset for the rig-wide public address system is visible at the extreme left.

mechanics, subsea engineers and drillers. Local residents who had experience and qualifications above the level of roustabout would be assessed on their individual merits.

This policy reflected the industry's approach to training new employees who had no experience in offshore drilling. The procedure of having new employees learn from the more experienced personnel was commonly practised and local hiring was mutually beneficial to the host country and to the contractor. Since the efficiency and safety of the drilling contractor's operation depended upon the crew working as a unit, it was considered impractical for the drilling contractor to replace too many of the crew too quickly. This practice could increase the risk of accidents and through inefficient operations cost both the contractor and the operator money in lost drilling time.

Local hiring policies in Canada, as they were applied to the offshore drilling industry, were complicated at the time of the loss by the existence of a dual regulatory system. The Federal Government and the Provincial Government both had policies which applied to the offshore industry. The major difference between them was in the rate of phase in of local personnel. The policy of the Federal Government regarding local preference was formulated by the Department of Employment and Immigration and communicated to the offshore industry through COGLA. Essentially, the policy did not set specific local resident quotas but relied upon the industry to reduce over a reasonable period of time the percentage of non-resident workers. COGLA recognized that too rapid a phase in of inexperienced personnel could jeopardize the safety of the operations and of the personnel and reduce the efficiency of the drilling program.

The provincial policy did not appear to accept that practice or its rationale. *The Newfoundland and Labrador Petroleum Regulations* (1977) and the guidelines to those regulations, published November 30, 1978, specified the positions in which residents should be employed immediately, and the positions in which non-residents should be phased out over time. The cumulative effect of the Province's regulations

3.5 A Sikorsky S-61 on the *Ocean Ranger's* helideck during a crew change. This type of helicopter was used to transfer personnel and light cargo from St. John's to the Hibernia Field. During these flights all passengers wore immersion suits and inflatable life preservers.

and guidelines on local hiring preference required a drilling contractor to replace 44% of the crew immediately upon the arrival of the rig and an additional 21% of the crew within one month. After one month of operations the drill rig was expected to have replaced 65% of its crew with Newfoundlanders.

Correspondence between ODECO and the Government of Newfoundland indicates that the Provincial Government was not satisfied with ODECO's performance under the local preference regulation. ODECO contended that it would employ qualified local personnel in all positions on the rig but that inexperienced and unqualified workers would have to be trained before they could advance to senior positions. The disagreement was thus not over the principle of local preference but over the rate of its implementation.

The reaction of the Province's Minister of Labour and Manpower was to advise Mobil that ODECO was in breach of Newfoundland's Petroleum Regulations and to request that Mobil correct the matter.[2] Steve Romansky, Mobil's east coast manager, testified that Mobil did not exert any pressure on ODECO to hire unqualified personnel. He expressed his company's concern that the Province and the industry were defining a qualified worker in different ways. The industry felt that an offshore worker became fully qualified after a considerable amount of "hands-on" experience whereas the Province felt that previous offshore experience was not essential for most of the positions on a rig.

Page 12/13: ". . . drilling rigs operating off our coasts should not . . . use non-resident workers for any of the following positions . . . (1) roustabout, (2) maintenance worker, (3) welder, (4) cook, (5) medic, (6) cafeteria worker, (7) steward, (8) radio operator and 50% of the roughnecks . . . In addition, non-residents should normally be phased out of the following positions within one month from the date the rig moves into our waters: (1) roughneck (remaining 50% of), (2) watchstander, (3) maintenance supervisor, (4) motorman . . . ."

Guidelines and Procedures Under Certain Sections of the Newfoundland and Labrador Petroleum Regulations, November 30, 1978

The controversy over local labour preference needs to be viewed in the context of the high level of unemployment in the province and the political pressures to maximize local involvement in offshore developments. Nevertheless, Provincial officials may have been overzealous in discharging their responsibilities. If a policy of local labour preference is to be implemented, a proper system for assessing the qualifications of those listed in the Offshore Employment Register ought to be established in consultation with industry. The rate of phase in of local residents ought to be controlled to ensure that acceptable standards of safety are not compromised. There is no evidence that the insistence upon the hiring of local residents caused or contributed in any way to the loss of the rig and its crew.

[2]Under Provincial regulations, the operator held permits to conduct exploratory drilling and was required to ensure its subcontractors complied with Provincial regulations.

COMMAND STRUCTURE

As mentioned in the Introduction, offshore exploratory drilling was regarded as essentially an industrial operation in a marine setting. The organization of command and responsibility on board the *Ocean Ranger* was very similar to that used in traditional land-based drilling operations. The crew structure reflected a predominant interest in an efficient industrial endeavour; the marine operations which ensured the stability and safety of the rig were relegated to a subordinate role, comparable to that of any other support group. This lack of attention to and emphasis on adequate marine practices was evident in the command hierarchy, in the provision of marine-qualified manpower, and in the training policies on board.

Part 109.109(a) "The master or person in charge shall-(1) Ensure that the provisions of the Certificate of Inspection are adhered to; and (2) Be fully cognizant of the provisions in the operating manual. . . ."

U.S. Coast Guard Code of Federal Regulations 46 CFR

Under the regulations of the U.S. Coast Guard the owner of a self-propelled MODU is required to "designate an individual to be master or person in charge of the unit" and the master or person in charge is required to ensure that "the provisions of the *Certificate of Inspection* are adhered to" and that he is "fully cognizant of the provisions set out in the operating manual." It was ODECO's policy to designate the toolpusher as the "person in charge" while the rig was moored on location. When the rig was lifting its anchors and was moving either under its own power or under tow to another site in the same field, the master became the "person in charge." If, however, it was moving from one Coastal State to another under its own power, an experienced "transit" master was sent to command the rig.

It is clear from the *Booklet of Operating Conditions* and from the evidence that Kent Thompson was in charge of the *Ocean Ranger* and that Captain Hauss was his subordinate. Thompson, however, had no marine qualifications even though in the event of an evacuation he was required to be in charge of one of the lifeboats. His knowledge of the sea and of rigs as marine structures was limited to his experience as a member of a drilling crew on a semisubmersible. He had no knowledge of the ballasting system or the principles of stability. And yet the ultimate authority and responsibility for the safety of the rig and its crew rested in his hands.

The participation of the Mobil drilling foreman in the control of the daily activities of the rig further confused the command issue. According to the contract between ODECO and Mobil, the Mobil foreman had the authority to issue instructions to the toolpusher on matters affecting the rig and the drilling operations. Since the drilling foreman represented the operator, his opinions would of necessity be given considerable weight but his instructions did not have to be followed by the toolpusher. Conflicts could therefore occur. An example of this arose during the period January 15-19, 1982, when a storm developed similar to the one encountered on February 14-15, 1982. At the time Mobil was testing a geological formation and though heaves exceeded allowable limits, Mobil requested that the hang-off and disconnect procedure be delayed. Don Leger, the toolpusher at that time, denied the drilling foreman's request and completed the process.

The role and responsibility of the master became evident from the testimony of the five former masters of the *Ocean Ranger* who appeared before the Royal Commission. The master was placed in the difficult position of having responsibility for marine matters without the authority to ensure that these responsibilities were properly discharged. His title belied his position. He had no marine crew under his direct and exclusive control. Even the ballast control operators for whom he was responsible took their orders regularly from the driller or toolpusher. The extent to which his advice on marine matters was sought or followed, depended upon his relationship with the toolpusher. The rig was simply a drilling platform and the master's presence on board the *Ocean Ranger* ensured compliance, if nothing else, with the requirements of the *Certificate of Inspection.*

ODECO provided a certificated mariner, Captain Hauss, as master although they did not provide him with training in the ballast control system, with a knowl-

"1. For certification as a Platform Manager are required:
1.1 Certificate of Competency . . . Master Mariner . . . and at least one year's practice in a senior post on a drilling unit.
1.2 Other theoretical and practical education and training . . . and experience in maritime handling and navigation of platforms . . . ."

Regulations dated 11 December 1981 concerning Certificates of Competence for Personnel on Drilling Units and Other Mobile Offshore Installations. Section 4.

"1. The Platform Manager
1.1 has the highest authority on board and is responsible for the stability and safety of the drilling unit . . .
1.8 is responsible for preparing instructions . . . as well as ensuring regular supervision of the following important operations: Changes in ballast, changes in trim, dynamic positioning operations, operations of the anchor systems . . . . ."

Regulations dated 23 March 1982 concerning the manning of Norwegian drilling units and other mobile offshore installations. Section 4.

edge of the intricacies of that system as it affected stability, or with an orientation to the *Ocean Ranger*. The *Certificate of Inspection* issued by the U.S. Coast Guard for the *Ocean Ranger* was even less stringent than ODECO's practice, requiring only a master with an Industrial Licence while the rig was moored on location. That licence had no status under United States law or Coast Guard regulations.[3] It was developed specifically as a licence for personnel on semisubmersibles of United States registry. However adequate this licence may be deemed to be for a master of a rig operating in the Gulf of Mexico, it is unsuitable for a person who is in charge of a semisubmersible operating in the hostile environment of the Grand Banks or anywhere else in the Northwest Atlantic. Stormy weather, drifting pack ice or icebergs, or a combination of these conditions may require the rig to be moved at short notice. Weather conditions on the Grand Banks are such that little dependence can be placed upon the possibility of flying a qualified mariner to the rig to assume command in the event of such occurrences.

In contrast Norwegian regulatory authorities now require that the person in charge of a MODU operating on their continental shelf and on all Norwegian Flag rigs operating anywhere in the world be a qualified master mariner with training, both theoretical and practical, in the stability and the ballast control of MODUs as well as of conventional vessels and also in basic drilling techniques. They deem a MODU to be a vessel which must be operated according to recognized marine practices. In the United Kingdom, MODUs under British registry must be under the command of a master mariner (British license). Those of foreign registry are subject to the requirements of the flag state. The United Kingdom, however, does not require additional training in stability and ballast control for masters of its rigs.

MARINE TRAINING OF CREW

An aspect of the ODECO manning practice which indicates the secondary importance given to marine matters was the lack of a marine crew and of marine training on the *Ocean Ranger*. All of the crew who were ODECO employees, and even to some extent the master, were hired to support the primary activity of the rig, the drilling operation. The crew did not have, nor were they required to have, Marine Emergency Duties (MED) training. The *Certificate of Inspection* issued by the U.S. Coast Guard required, in addition to a master with an Industrial License, a marine crew consisting of two able seamen, one ordinary seaman and a sufficient number of certificated lifeboatmen to man the lifeboats. There appears to be some confusion regarding the number of lifeboatmen required because of the increase in the number of lifeboats. But whatever interpretation is placed on the regulations, whether the number required was 4, 6, or 8, (the U.S. Coast Guard Marine Board of Investigation interpreted it as 4), at the time of the loss, the *Ocean Ranger* was undermanned by a minimum of 3 certificated lifeboatmen and 2 able-bodied seamen. ODECO's stated operating policy was to ensure that an adequate number of its industrial crew would hold the marine licences required by the U.S. Coast Guard. In fact only one employee, the rig mechanic, had marine certification. The operations manager of ODECO based in St. John's testified that he relied upon the master to ensure that the U.S. Coast Guard manning requirements were met. He stated that maintaining

[3]The Industrial License has no definition or status in law or regulation. It was developed by The Coast Guard Marine Inspection Office in New Orleans, LA as a license for offshore oil field personnel employed on semisubmersible drilling rigs who passed the test administered by that office. Passing the test and obtaining the license is not a legal or regulatory requirement for employment on board a semisubmersible drilling rig as master. However, the Coast Guard accepts the Industrial License on self-propelled, semisubmersible drilling rigs in lieu of the normally required Unlimited Master License while such rigs are on location for the purpose of drilling. *Marine Casualty Report: Mobile Offshore Drilling Unit* Ocean Ranger, *O.N. 615641, capsizing and sinking in the Atlantic Ocean on 15 February 1982, with multiple loss of lives:* U.S. Coast Guard, 20 May 1983, p. 30, footnote 1.

the required number of marine crew was complicated by the high percentage of Canadians on board because Canadian marine certification was not accepted by the U.S. Coast Guard. No evidence was given, however, as to the number of Canadians with marine certification. In fact Canadian regulations did not require marine training or certificates for crew members employed on rigs operating offshore. The explanation given by ODECO's operations manager, who was responsible for selecting and hiring all new employees, was not persuasive.