Drillship Pélican

IHC offshore division

Drillship Pélican

Introduction

The world consumption of oil has increased five-fold since 1950 and has more than doubled in the last ten years. At the present rate of industrial expansion, demand may be expected to double again by 1980. Allowing for planned expansion of production, the current reserves of oil beneath the continents will last for only 20 years and are thus inadequate. It is thus vital that fresh sources should be found, and indeed the oil industry is currently engaged on a massive programme of expansion, not only in existing areas but also in completely new ones. This explains the search for offshore deposits. In the course of history, huge areas of land have been engulfed by the sea; scientists are convinced that this former land contains immeasurable reserves of hydrocarbons. Data so far published suggest that no less than one-fifth of all hydrocarbon reserves lie beneath the continental shelf.

Already, numerous searches of the continental shelf have been made, at depths down to 330 feet. For these, conventional drillships have been used and, to an even greater extent, platforms of various types. Despite their remarkable performance, such rigs have the disadvantage of being dependent upon the nature of the seabed on which their legs rest and in which their anchorage systems are secured. Moreover, the shifting of a rig is and will always be a complicated and time-consuming operation.

The need arose for an efficient, safe and economic drilling tool capable of working in any part of the world, on the continental shelf or in the deeper waters beyond, and capable of moving rapidly from one location to another: in short, a more flexible and versatile tool.
The TOTAL group, which possesses immense technical experience in exploring and exploiting undersea oil and gas deposits, succeeded in its efforts to find a suitable solution.
41 % of the group's drilling concessions are in widely scattered areas of the world.
With previously established specification data as its starting point, a study committee set up by CFP, the parent company of the TOTAL group, proceeded to draw up a plan for a drillship of a revolutionary type. In the second phase, SOMASER (Société Maritime de Services), in which Compagnie Navale des Pétroles, (a subsidiary of CFP) Foramer and Compagnie Générale Doris participate, was formed to handle the design, construction and equipping of the vessel.
Foramer is the drilling company and as such is primarily responsible for the economic operation of the vessel. The elaboration of the plan and the actual construction of the drillship were undertaken by IHC Holland.
The vessel went into service in April, 1972.

The drillship *Pélican* has been designed to carry out offshore petroleum exploration in deep water areas with the utmost efficiency and safety, and thus at the most economical operating cost. She has been designed to cope with a wide range of environmental conditions.

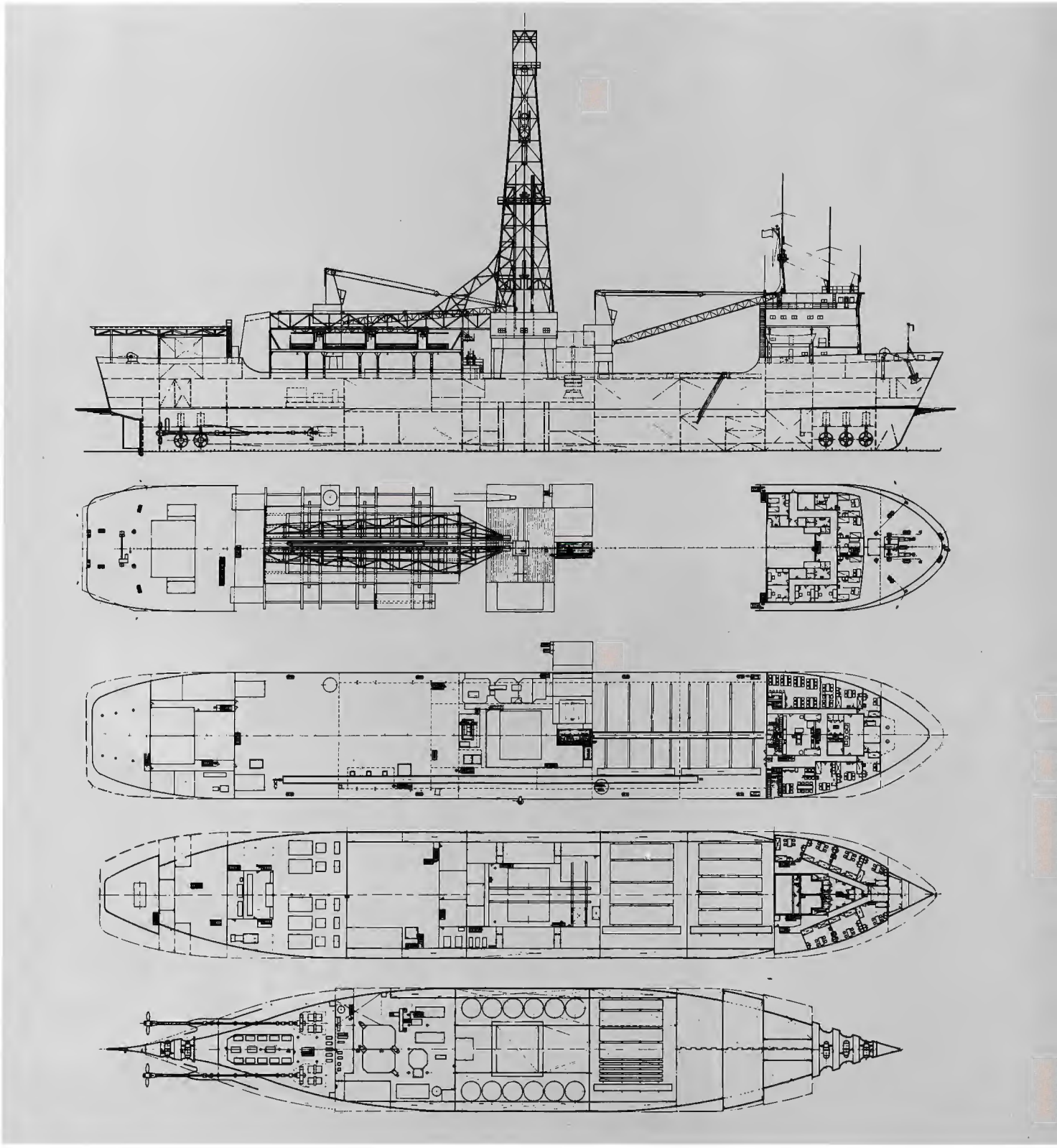
The following basic requirements have been taken into consideration:

- high steaming speed and ability to operate in all climatic areas
- maximum self-sufficiency: external logistic support, both offshore and onshore, is kept to a minimum
- maximum operational flexibility, achieved by severe limitation of the physical connections between the ship and the seabed
- complete mechanization of the handling operations on board.

The *Pélican* was built by IHC Holland at their Offshore Division at Schiedam, Holland, under the supervision of Bureau Veritas and is classed ✠ 1A1 - ICE B - Aut - "drilling vessel". All international regulations and recommendations applying to this category of vessel have been complied with.

The *Pélican* is equipped with a fully dynamic positioning system, free of any mechanical mooring device.


TOTAL



Main data

Length overall, approx.	(492 ft)	150.00 m
Length b pp	(450 ft)	137.00 m
Beam	(70 ft)	21.35 m
Depth	(41 ft)	12.50 m
Maximum draught	(24 ft)	7.32 m
Service speed, approx.	13 knots (at 23 ft draught)	

Loading capacities

A variable load of the order of 7,700 tons can be carried.
The maximum capacities and a typical load breakdown, in metric tons (2,205 lbs), are given below. With a maximum load, the drillship has a 100-day self sufficiency.

	Max. capacity tons	Typical loading tons
Fuel: oil	3,800	3,300
Water, drinking SB	190	160
Water, drinking PS	190	160
Water, ballast	1,700	850
Bulk, mud and salt	1,150	1,050
Mud (sacks)	220	200
Mud (liquid, 1,700 bbls)	425	275
Drill string	470	470
Casing pipes	950	850
Riser pipes	340	170
Stores	320	215
		7,700

Personnel

Accommodation is provided for a crew of 80, comprising marine and drilling crews, operators and others. If required, the quarters can be segregated to meet local conditions.

Temperatures

The working areas and machinery spaces are suitable for operation in air temperatures ranging from 95 °F (35 °C) to 5 °F (–15 °C) and seawater temperatures up to 93 °F (34 °C).

Dynamics

The vessel's metacentric height (GM) can be varied. In typical loading situations, the GM ranges between about 0.25 and 1.50 m (10″–5′). Two detuning tanks with a total capacity of about 950 tons are situated above main deck level.

These enable the wave frequency and the frequency of the rolling motions to be mismatched.

A free surface anti-rolling tank is used to decrease the roll amplitude.

The survival dynamic conditions for the ship and its equipment in steaming condition are in accordance with the classification requirements.

The drilling dynamic conditions for the derrick and other similar equipment are as follows:

wind	:	100 mph
permanent list	:	3 degrees
roll amplitude	:	10 degrees/10 sec
pitch amplitude	:	4 degrees/10 sec
heave	:	12 feet/8 sec

General layout

The hull has been constructed by the longitudinal frame system and includes bottom and wing tanks for the storage of fuel oil and seawater ballast. These extend over the greater part of the vessel's length. There are five main sections. From fore to aft, these are:

- accommodation and navigation section
- pipe storage section
- drilling well section
- mud pump section
- power and propulsion section.

1. Accommodation and navigation section

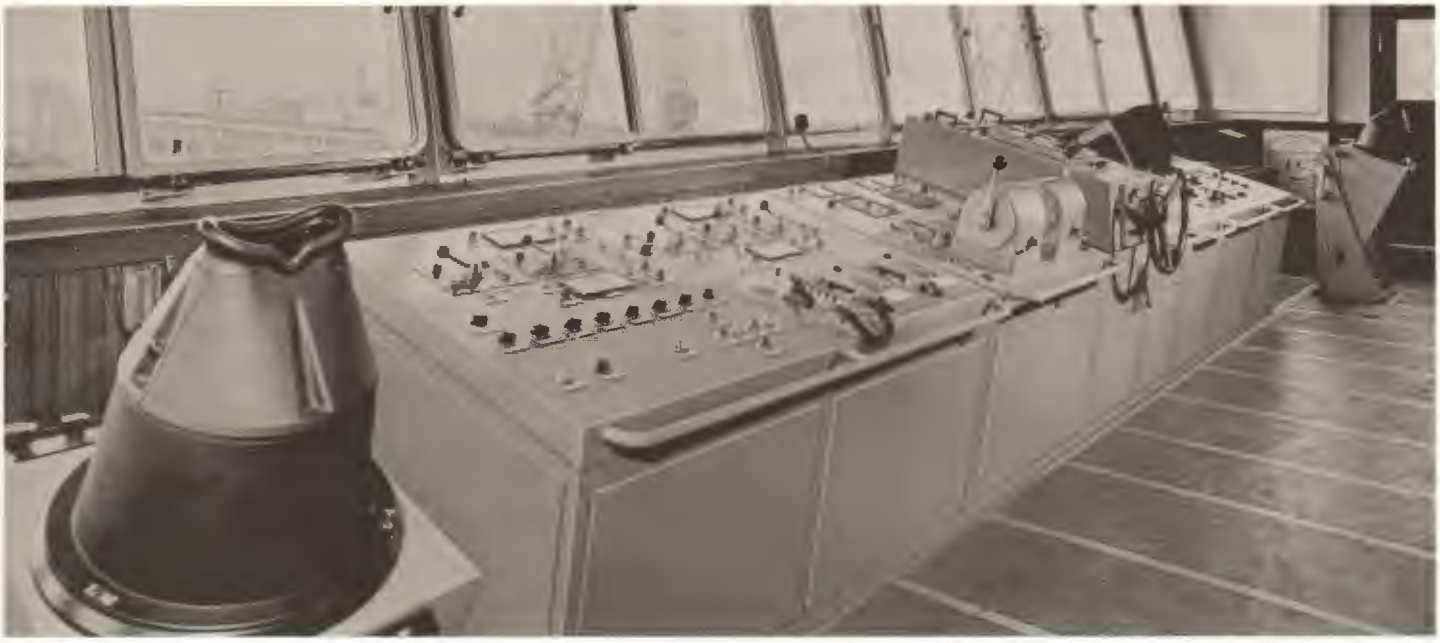
The lower part of the hull and the bow include various tanks and three transverse thrusters for the positioning system.
The living quarters, together with technical and navigation spaces, are distributed over 7 decks. From bottom to top, these are:

(1) 400 m³ (13,500 cu ft) dry provision store
(2) 90 m³ (3,000 cu ft) deep freeze (–22 °F) cold rooms and crew accommodation (28 persons)
(3) galley, messrooms and accommodation for 16 persons on main deck
(4) technical spaces (4), conference room, sick bay (2 beds) and accommodation for 9 on forecastle deck
(5) recreation room and accommodation for 10 persons on boat deck
(6) accommodation for 15 persons on bridge deck
(7) wheelhouse, chartroom, radio, etc. on navigation deck.

The following cabins are provided:

- 16 single-berth
- 12 single/twin-berth
- 10 4-berth

The forward detuning tank (450 tons) is enclosed within the superstructure.



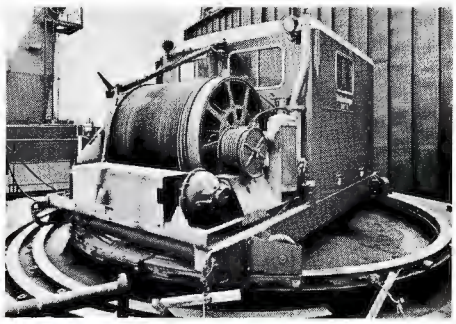
2. Pipe storage section

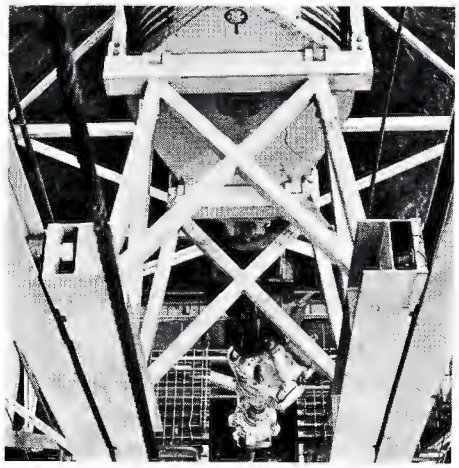
The main hold and two tweendeck holds are devoted to the storage and mechanical handling of drill and casing pipes. The remaining hold space is occupied by water ballast, fuel tanks and a free surface anti-rolling tank.

A typical assortment of pipes and fittings would be:

- 155 tons (340,000 lbs) of drill collars (4 sizes)
- 17,500 ft of 5″ drill pipes (2 grades)
- 17,500 ft of 3½″ drill pipes (2 grades)
- 230 ft of 30″ casing
- 2,560 ft of 18-5/8″ casing (2 grades x lb/ft)
- 8,200 ft of 13-3/8″ casing (3 grades x lb/ft)
- 18,700 ft of 9-5/8″ casing (3 grades x lb/ft)
- 14,600 ft of 7″ casing
- various equipment (approx. 20 tons).

This would weigh about 2,400 tons in all.
Various racks on the main deck allow for the temporary or emergency storage of pipes; the total area is of the order of 300 m² (3,300 sq ft).
A 40-ton revolving crane facilitates handling of the pipes.





3. Drilling well section

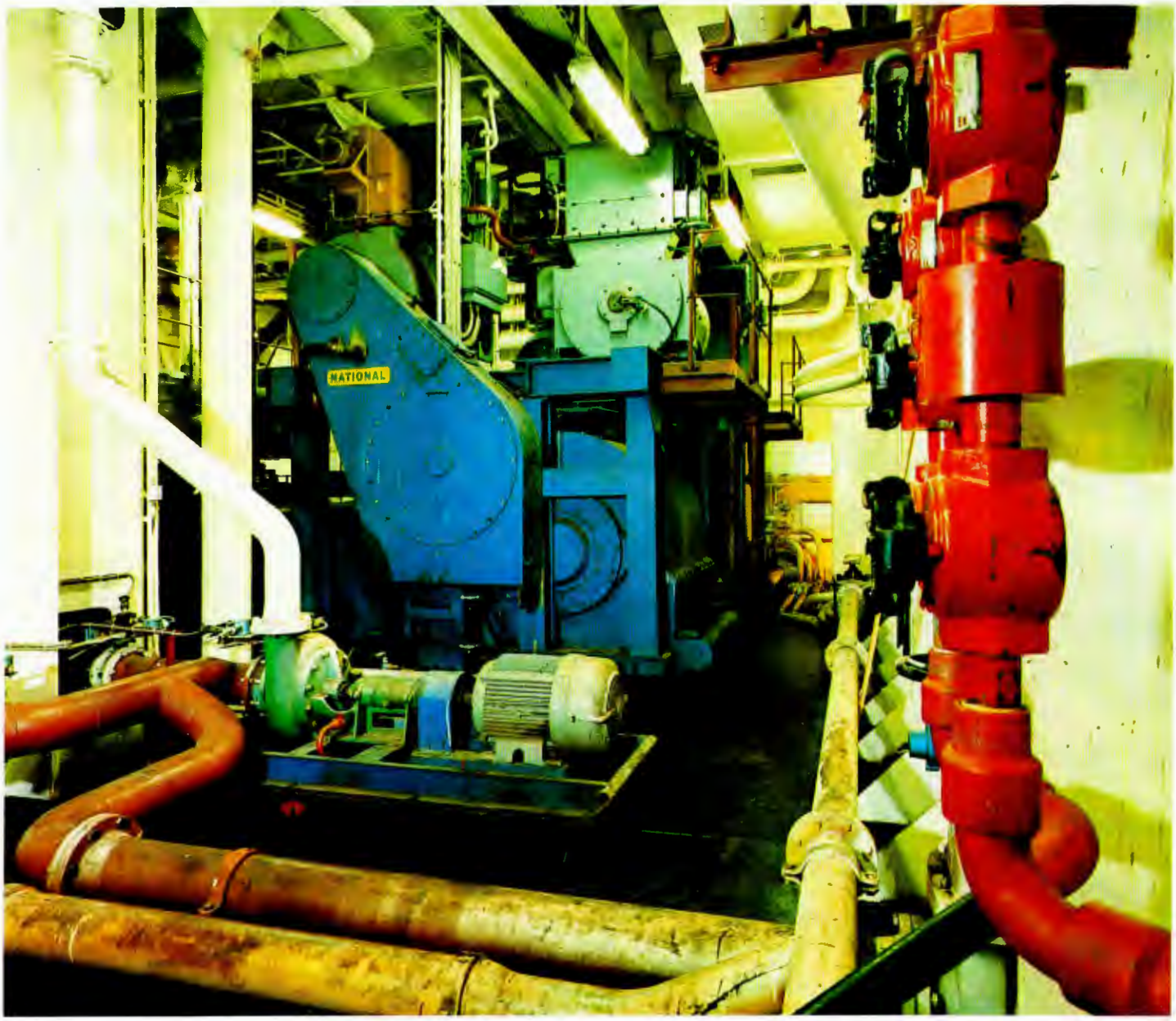
A large quantity of drilling equipment is concentrated in this section:

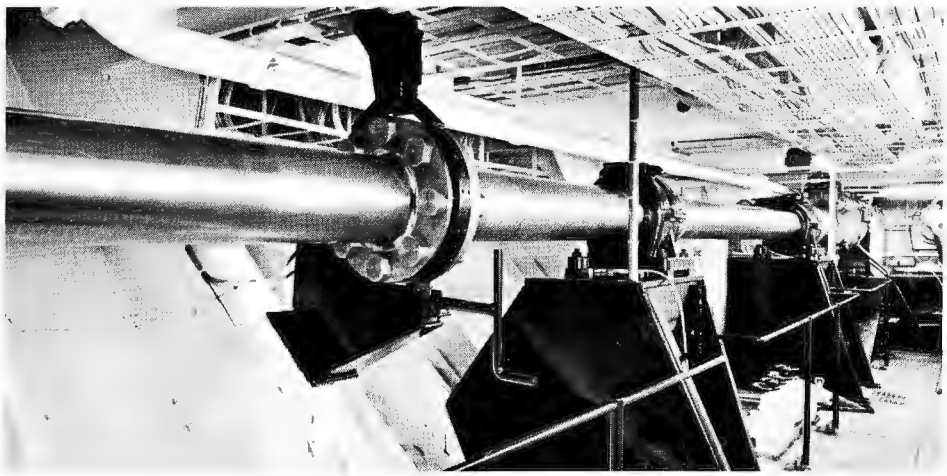
- a 23′ 7″ x 27′ drilling well (7.20 m x 8.25 m)
- a 10′ 6″ x 12′ 6″ diving well (3.20 m x 3.80 m)
- two sets of 6 pneumatic bulk mud hoppers
- various storage and technical spaces
- the BOP handling and maintenance installation
- the drilling floor with associated equipment
- the active mud tanks
- the riser tensioning installation
- the deep diving installation
- the drilling derrick and heave compensating device
- a geological laboratory and drilling crew dayroom
- Schlumberger unit
- a cabin from which all drilling operations are controlled.

4. Mud pump section

Situated at tank top level, the mud pump room accommodates two main mud pumps, the cementing unit, mud storage and preparation tanks, a 320-ton salt storage and saturated brine preparation tank, and various centrifugal pumping units.
At tweendeck level is a mud additives storage, handling and extraction installation.

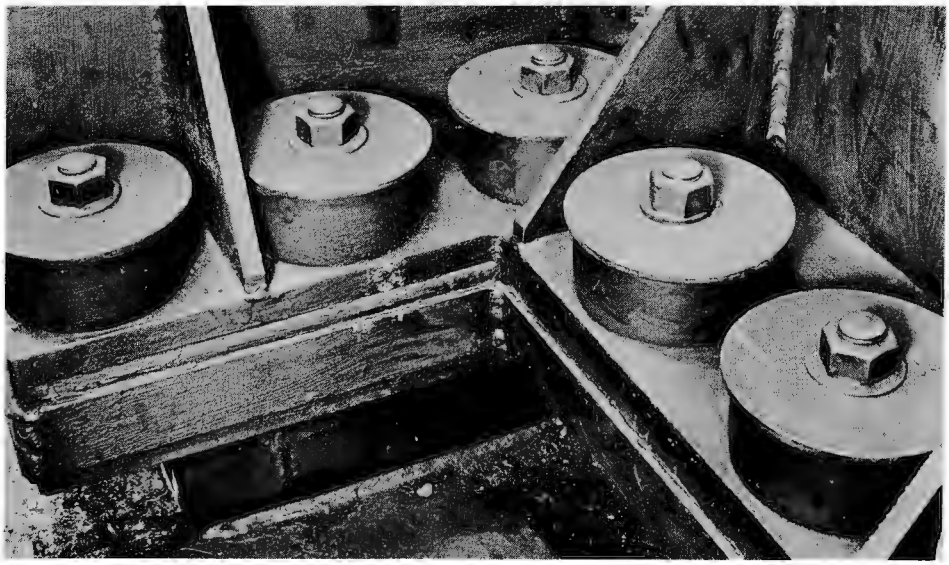
The riser storage and the automatic horizontal racking system are located on and above the main deck. The riser storage capacity is of the order of 1,200 ft each of 16″ and 24″ strings of pipes, plus accessories.

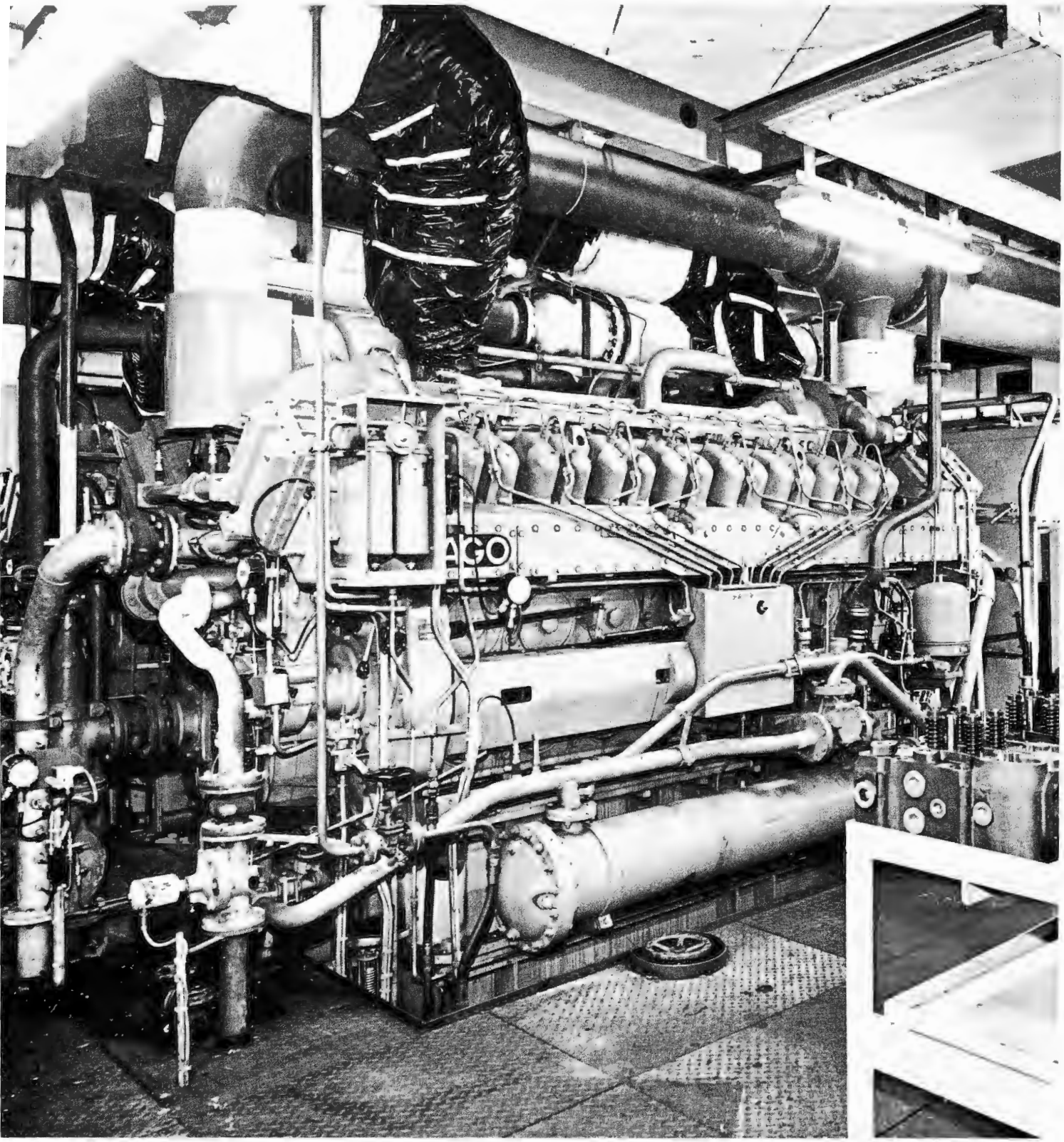




5. Power and propulsion section

The lower part of the hull accommodates the two main propulsion shafts and associated driving motors, plus two transverse thrusters identical to the three situated forward, the latter being rubber mounted.
The five 3,000 kVA main generators, the secondary generators and the switchgear, transformers, rectifiers, etc. are on the two levels situated above.
Various technical spaces such as the steering gear room, a 500-ton detuning tank and a 69 ft diameter deck suitable for a 6-ton helicopter are provided aft.

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Handling equipment

Ample handling facilities have been provided to increase the efficiency and safety of the operations.

1. Cranes

One 40-ton, 30.5-m (100-ft) boom, electric revolving crane is situated on the starboard side, forward.
One 30-ton, 30.5-m (100-ft) boom crane is situated aft on the port side.
Both are suitable for all-weather operation and can be controlled either from an enclosed cabin or remotely. Between them, these cranes cover most of the main deck area, from the rear of the forward superstructure to the helicopter deck.

2. Automatic drill pipe racking system

The horizontal racking installation (G.A.A.A.) can accommodate 192 stands of 91 ft triple drill pipes. Using a combination of gantry cranes, lifting device and a back-up beam, each triple of drill pipes is transferred to the vertical position inside the derrick. Three tongs move the drill pipes to the derrick centre, where they are joined with the assistance of a Byron-Jackson 60,000 lb/ft power tong and Varco power slips.
Most of the operations are integrated in a fully automated system. Using a "dual speed" travelling block, a full cycle takes about 65 seconds to complete.

Manual operation is also possible. Drill collars are stored vertically and are handled by means of the same three tongs installed inside the derrick. Up to about 7,500 ft of drill pipe can also be racked vertically with the same mechanical aids.

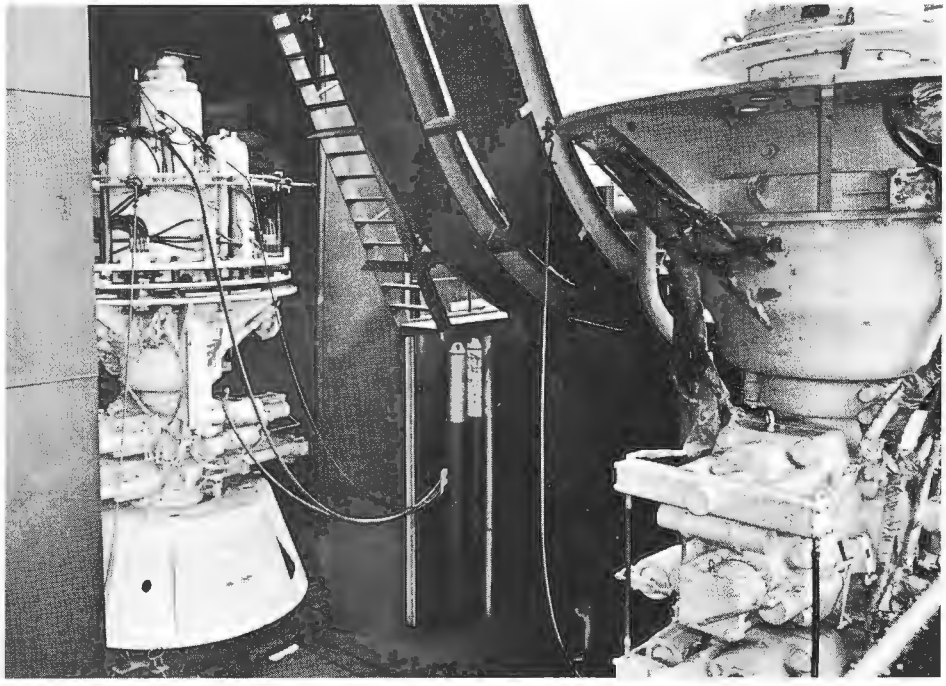
3. Pipe handling

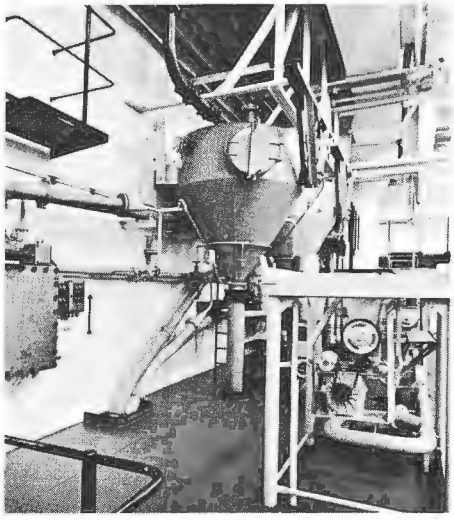
Five gantry cranes serve for pipe handling in the three storage holds and for the movement of riser pipes on the after areas of the main deck. A longitudinal conveyor is installed to facilitate the transfer of riser and drill pipes along the hull. A mechanical device is used to transfer the casing pipes from the main deck racks to the drilling floor.

4. BOP handling

Two hydraulically-operated carriages enable two stacks of BOP (up to 70 tons and 28 ft in height) and the base plates to be moved between the storage and maintenance areas and the drilling well centre.

Two 12-ton hydraulic hoists are provided for raising or lowering equipment from or to the seabed.

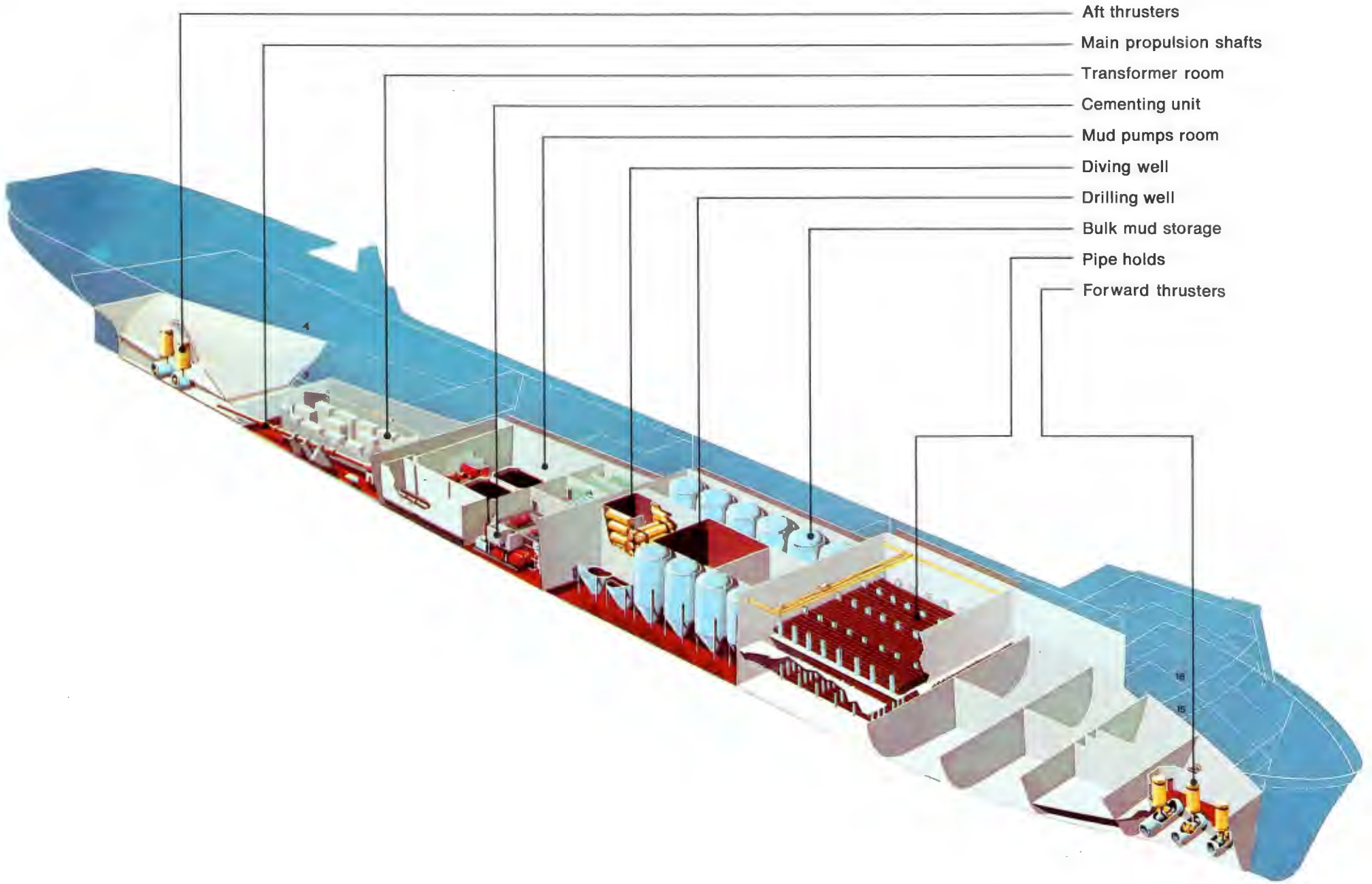


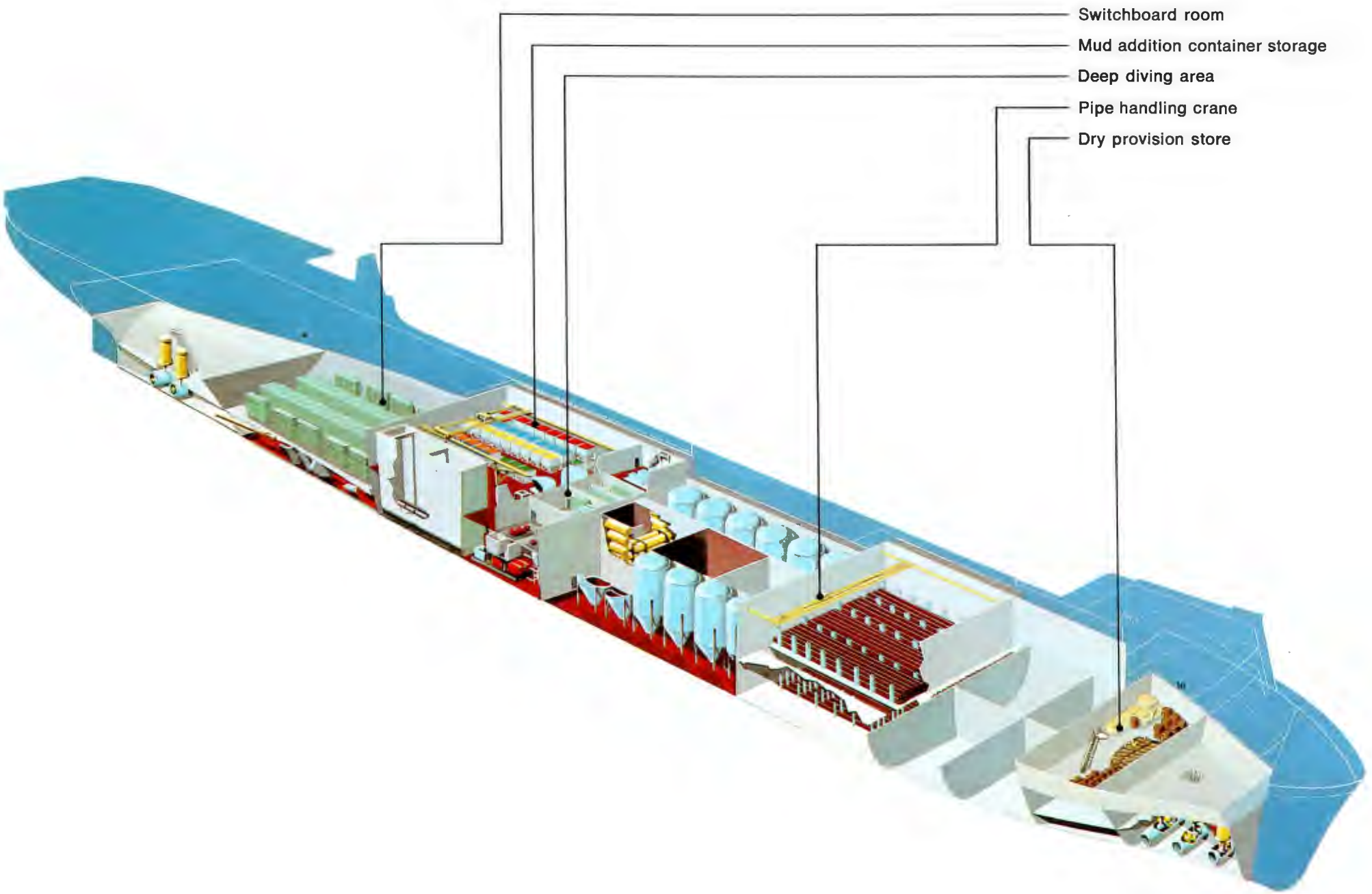


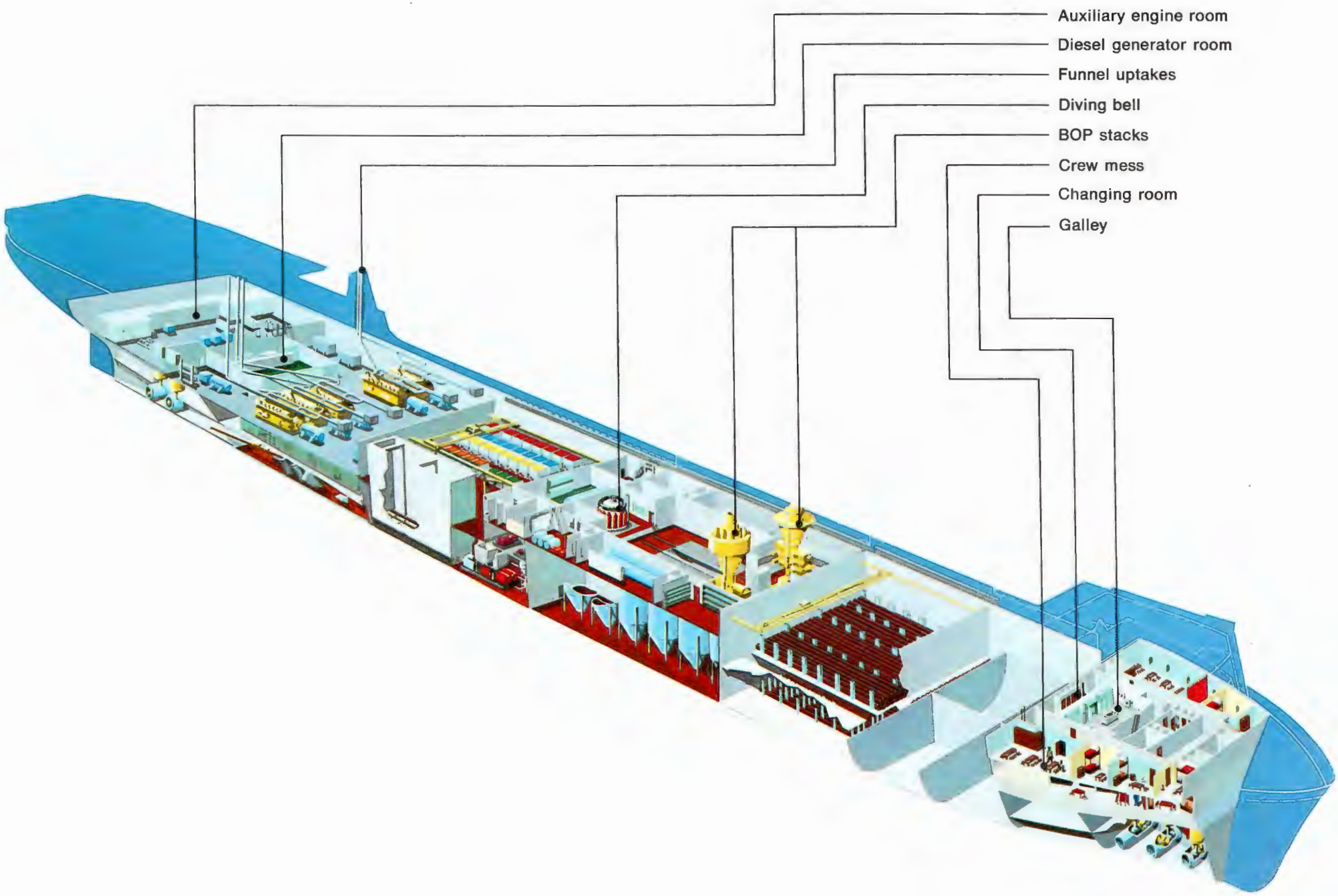
5. Mud products and additives handling

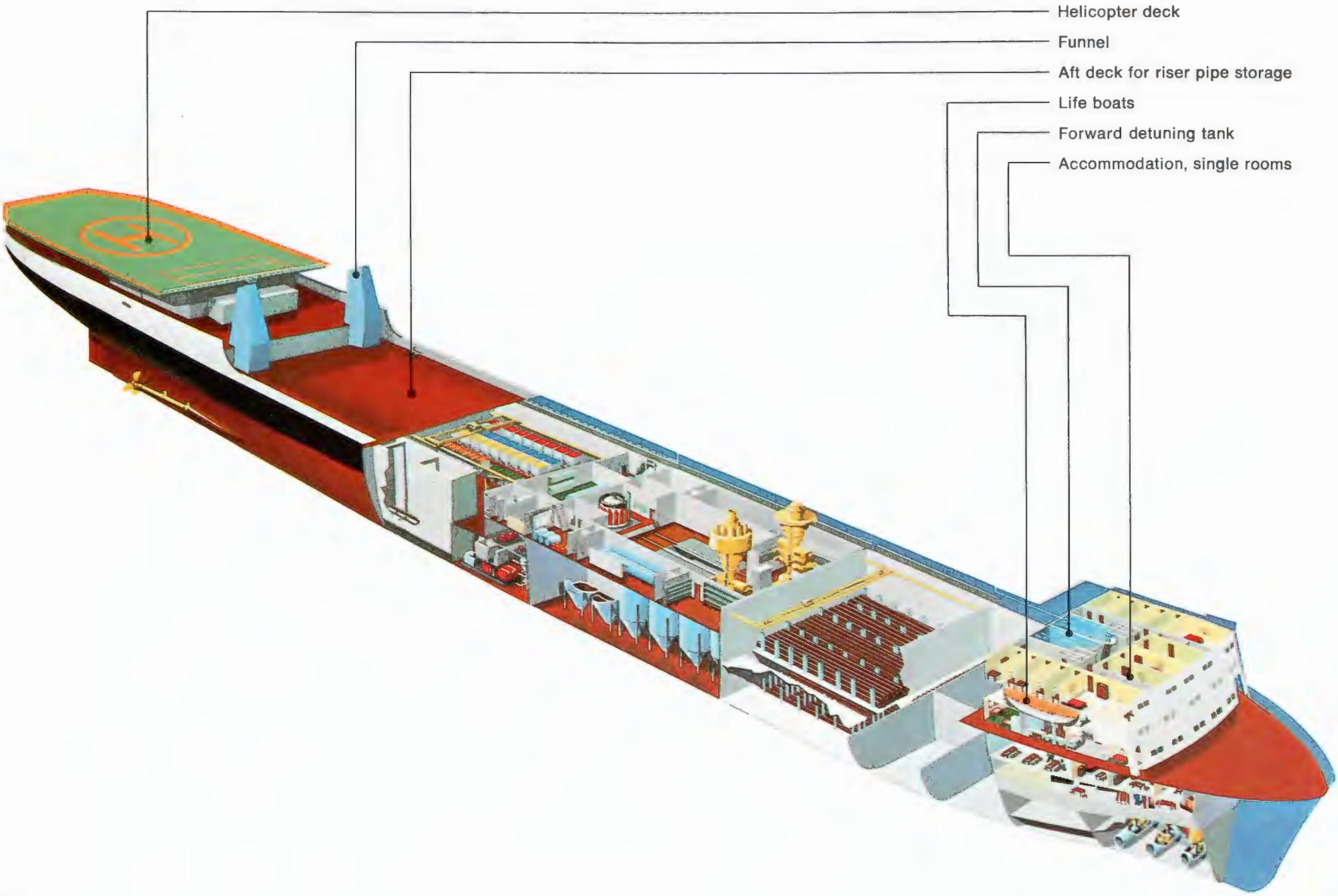
A remotely controlled pneumatic installation permits the storage of 45 m³ (1,600 cu ft) each of cement, barytes and bentonite in 12 silos, and the transport of these materials to three surge tanks. A typical storage programme is 500 tons of barytes, 250 tons of cement and 80 tons of bentonite or similar products.
The mud additives and chemicals are stored and preserved in 140 or so containers. A gantry and a turntable are used to handle the containers throughout the storage area and to transport them to the control extraction stands for mud processing.

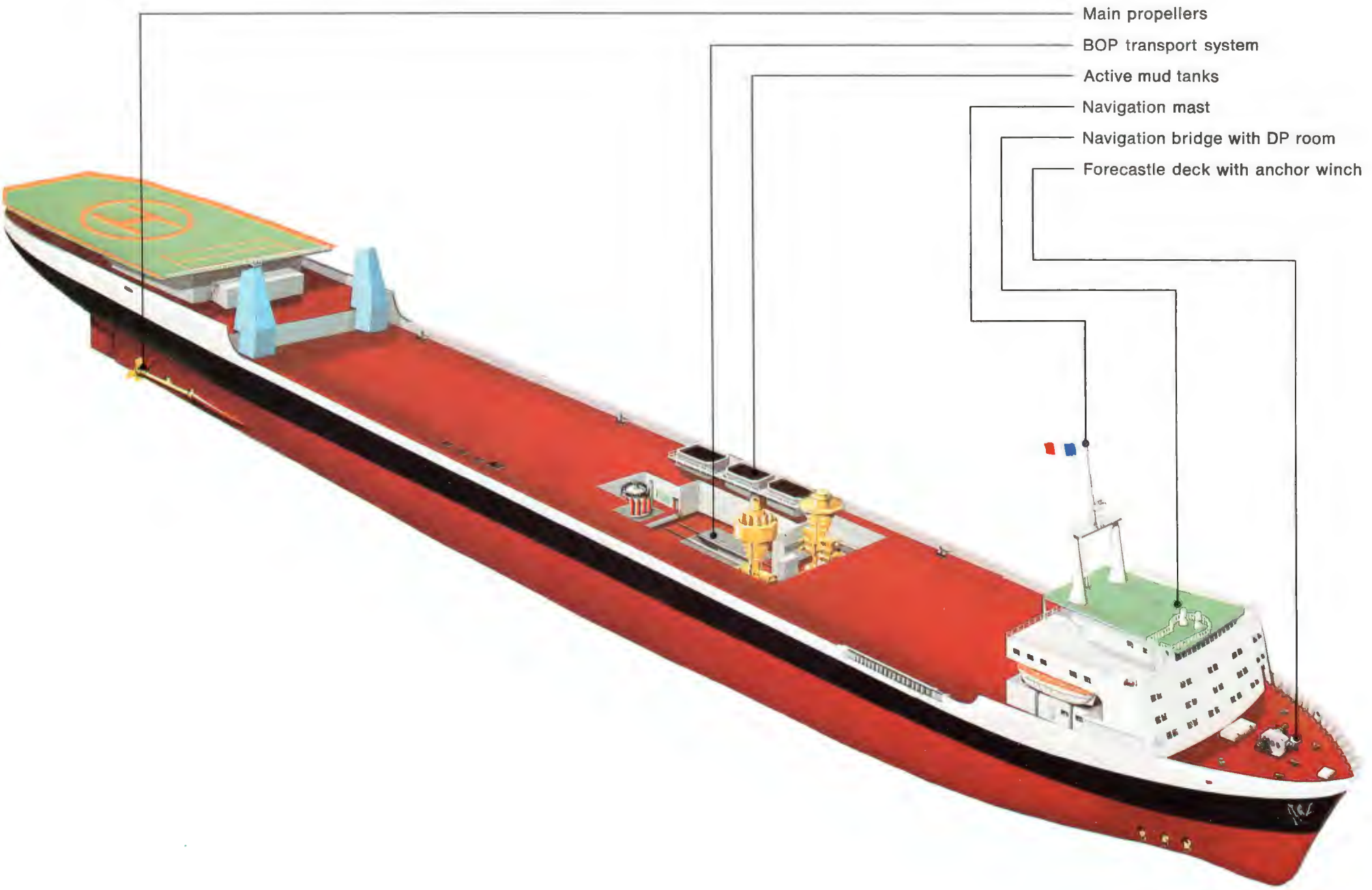
Progressive cutaway illustration

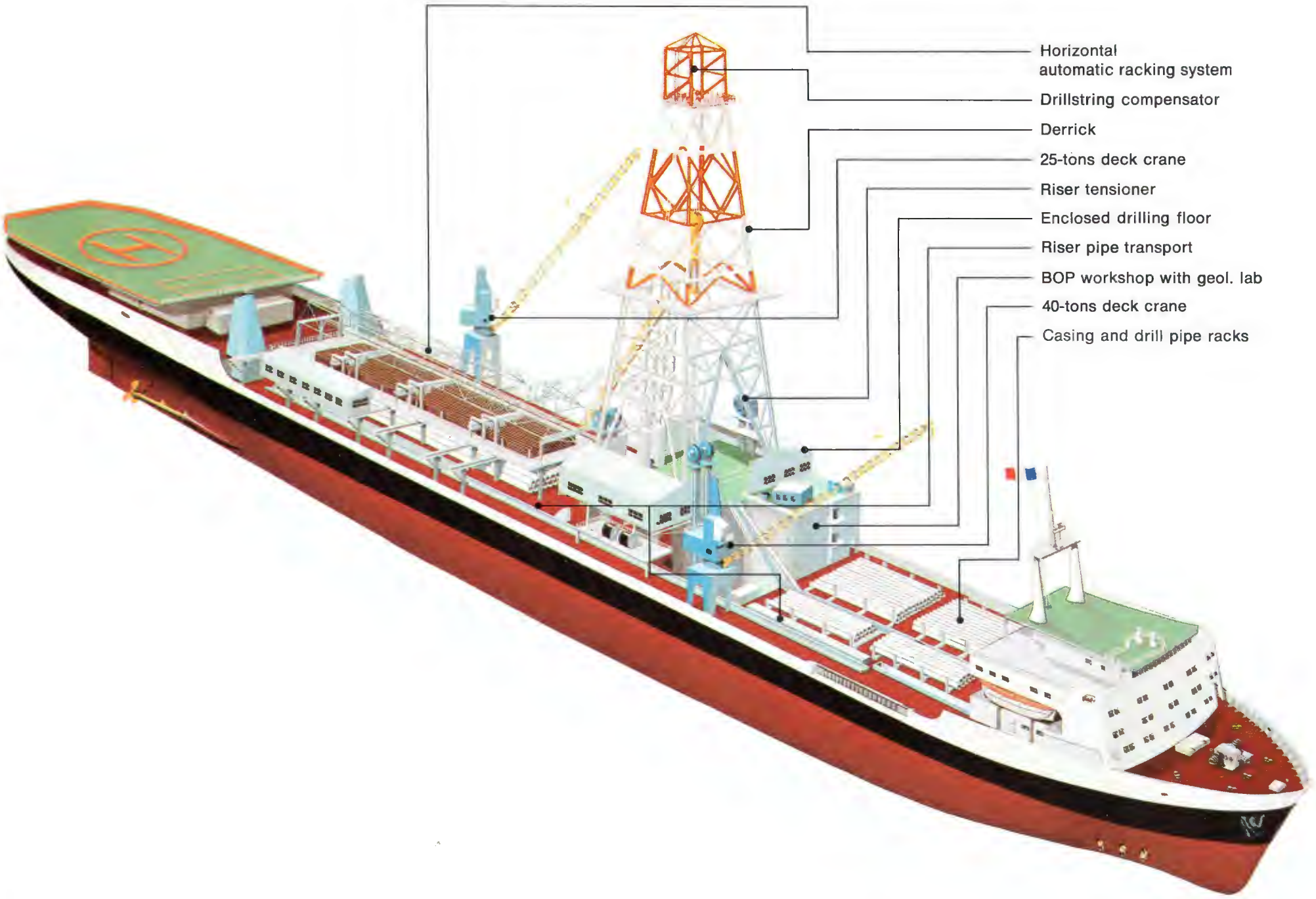

Aft thrusters
Main propulsion shafts
Transformer room
Cementing unit
Mud pumps room
Diving well
Drilling well
Bulk mud storage
Pipe holds
Forward thrusters


Switchboard room
Mud addition container storage
Deep diving area
Pipe handling crane
Dry provision store


Auxiliary engine room
Diesel generator room
Funnel uptakes
Diving bell
BOP stacks
Crew mess
Changing room
Galley


Helicopter deck
Funnel
Aft deck for riser pipe storage
Life boats
Forward detuning tank
Accommodation, single rooms


Main propellers
BOP transport system
Active mud tanks
Navigation mast
Navigation bridge with DP room
Forecastle deck with anchor winch

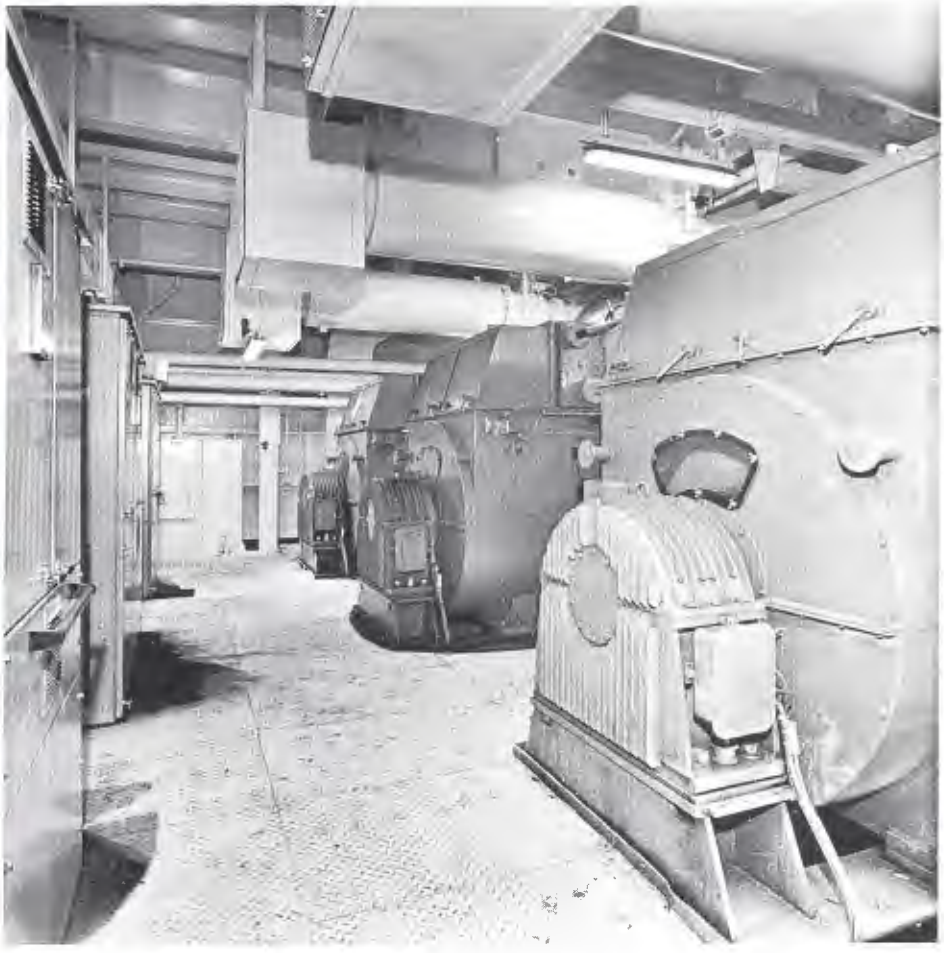

Horizontal
automatic racking system
Drillstring compensator
Derrick
25-tons deck crane
Riser tensioner
Enclosed drilling floor
Riser pipe transport
BOP workshop with geol. lab
40-tons deck crane
Casing and drill pipe racks

Electrical installation

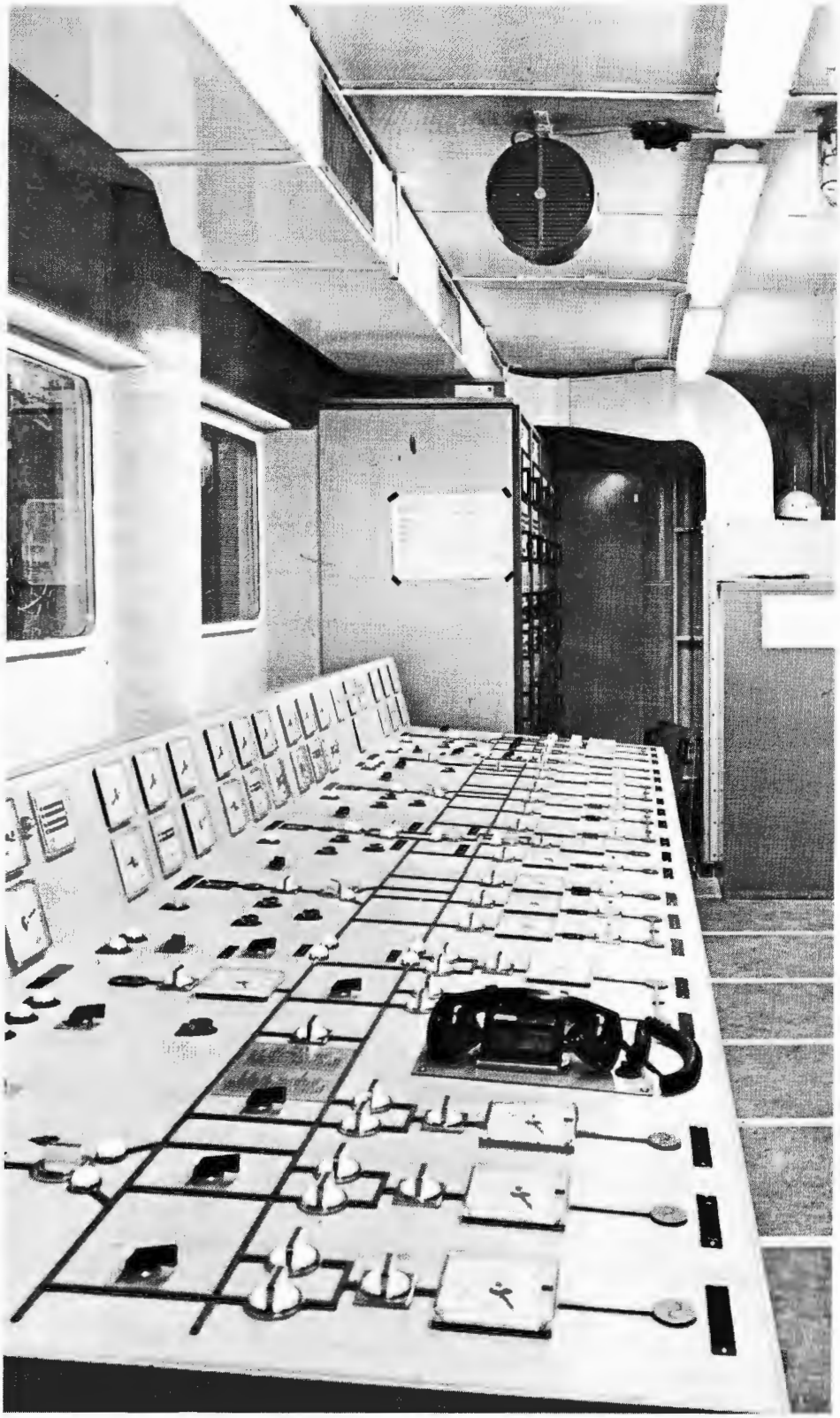
Power for the various functions on board is provided by five diesel-driven main generators.

The diesel engines are SACM (Mulhouse, France) type AGO-16 and each delivers 3,400 hp at 1,200 rev/min.

The generators and other principal electrical equipment were supplied by Jeumont-Schneider (Paris). The main generators each deliver 2,400 kW, 3,000 kVA at 5,500 V, 60 cycles, AC. The 5,500 V circuit provides the power to 9 identical 1,500 hp motors, 4 of which are used to drive the main propellers, while the remaining five each power a transverse thruster. The basic AC current is passed through a 1,500 kVA transformer to provide current at 440 volts for general circuits and at 220 volts for lighting.



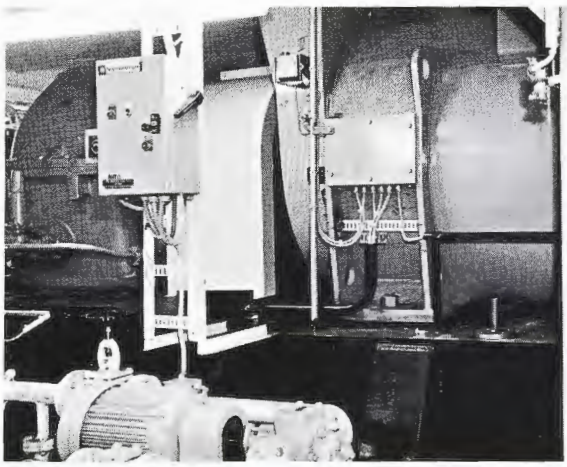
The 5,500 volt AC current is transformed and rectified by thyristor circuits to provide DC current for the drilling installation.
The National 1625 DE drawworks is powered by two 800 hp electric motors; and the rotary table and mud pumps by one and four similar motors, respectively. Two 400 hp motors drive the cement pumps.
All motors are of the flameproof, water-cooled type for maximum safety.
A 950 hp, 750 kVA standby generator and an emergency generator are also available to feed the general circuits.
The entire installation is highly automated and complies with the Bureau Veritas "AUT" classification rules.

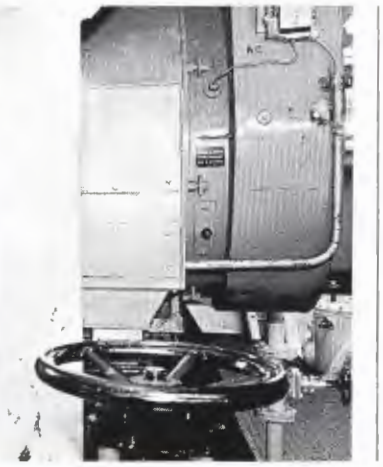


Propulsion and dynamic positioning

1. Propulsion

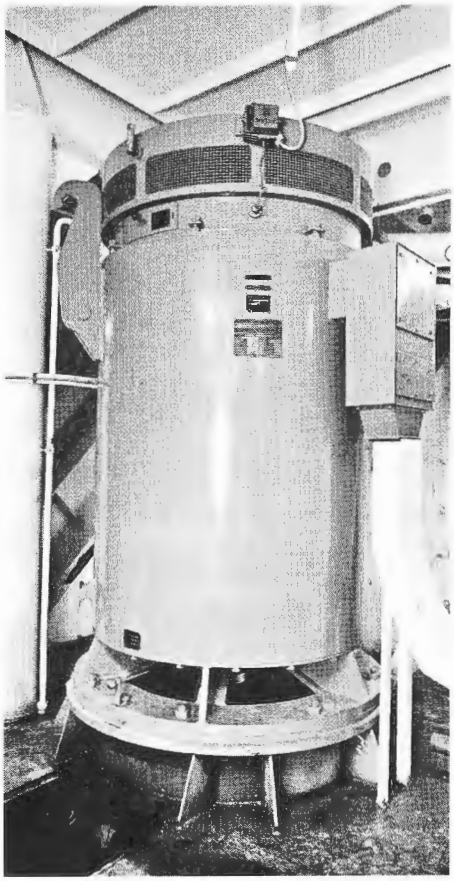
The vessel is propelled by two 13 ft diameter controllable pitch propellers running at a constant speed of 145 rev/min, each of which is driven, via reduction gearing, by two 1,500 hp motors. These give the *Pélican* a service speed of 13 knots.
The main propellers also provide the required longitudinal thrust for dynamic positioning. The lateral thrust is exerted by five 8 ft diameter transverse propellers, each driven, at 230 rev/min, by a 1,500 hp motor. Three are situated forward and two aft.





2. Dynamic positioning

The function of the dynamic positioning systems is to continuously and accurately maintain an assigned ship station during long periods of time by monitoring the vessel's behaviour and instituting the necessary action to correct deviations. The equipment was supplied by Alcatel, Paris. The studies concerned with its development were carried out by Alcatel and IHC Holland with the assistance of the TNO Institute in Delft, and were supported by tests at the Netherlands Ship Model Basin at Wageningen, and the wind tunnel in Hamburg.



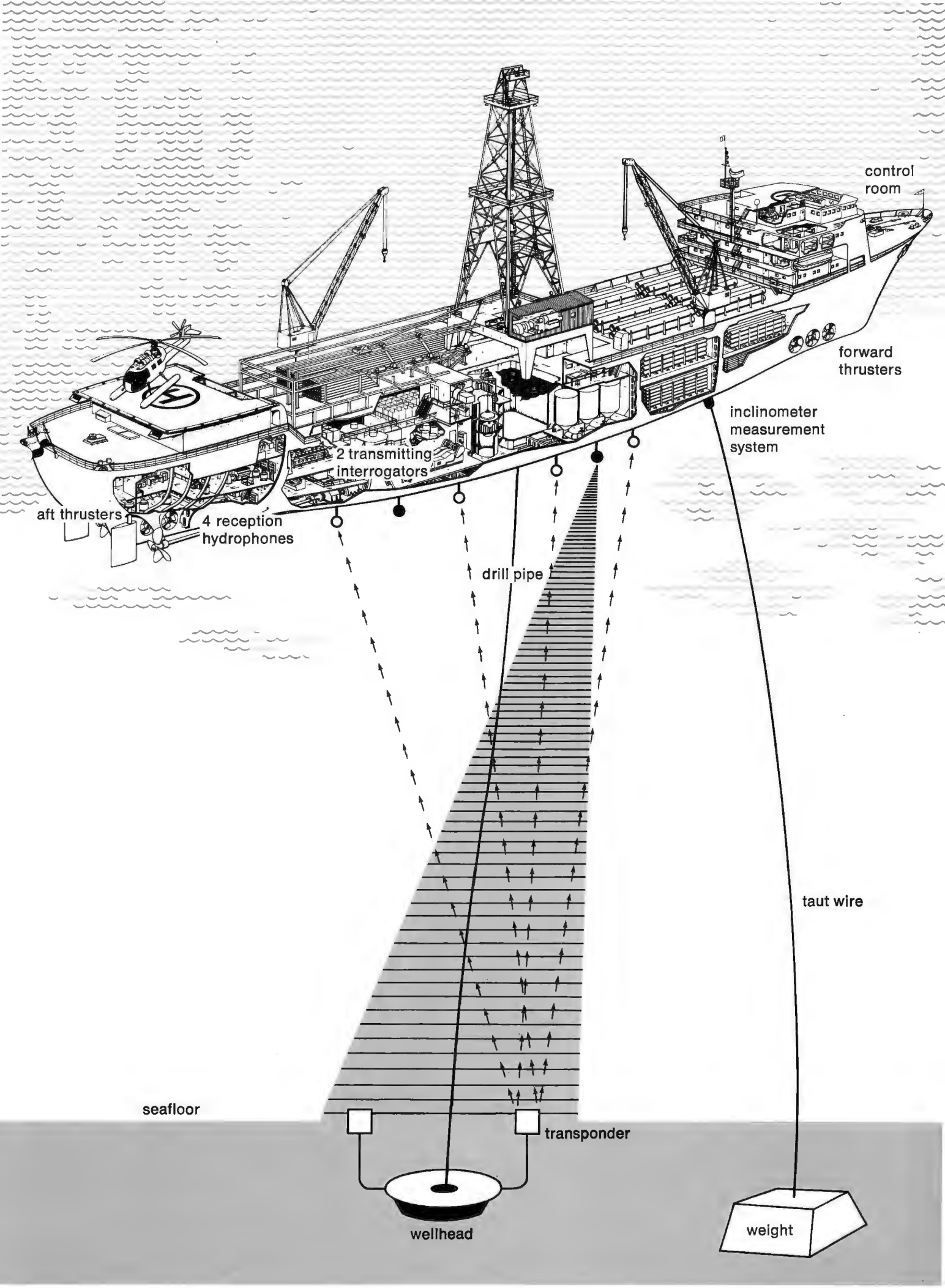
The basic design data are:

- water depth: 50-300 m (165-1,000 ft)
- maximum ship deviation: 6 % of the water depth
- heading accuracy: 2
- wind velocity (sustained): 45 knots
- wind velocity (gust): 65 knots for 60 seconds with 10-second transit time
- current velocity: 2 knots
- wave spectrum:
  significant height: 4.90 m (16 ft)
  significant period: 12 sec.

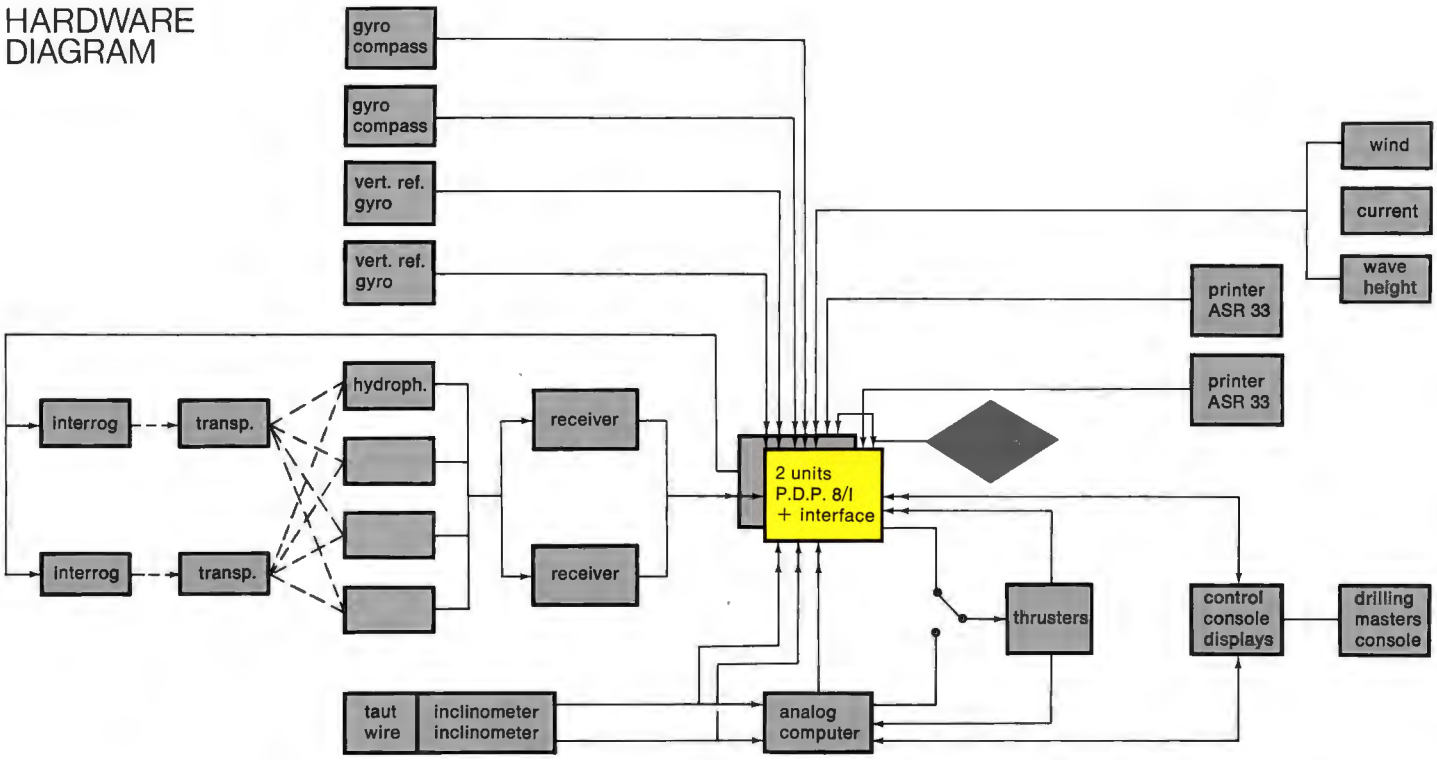
The actual ship location is obtained from an acoustic system and a taut wire device.

Two identical digital computers are used. Their main functions are to monitor the acoustic interrogator system, to calculate the actual ship location and behaviour, and to transmit commands to the propellers.

Secondary tasks include providing a visual display of the ship's position, internal and mutual checking, storage of actual data, etc.

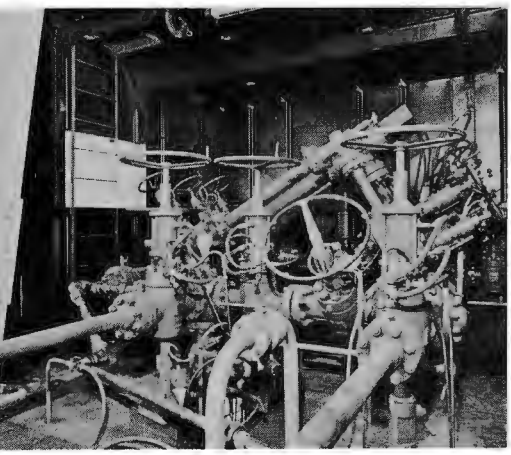

control room
forward thrusters
inclinometer measurement system
2 transmitting interrogators
aft thrusters
4 reception hydrophones
drill pipe
taut wire
seafloor
transponder
wellhead
weight

HARDWARE DIAGRAM



An analogue computer, to which all incoming data are fed, is linked to the digital computers. Either computer can operate alone in the event of failure of the others.
The entire system can be operated in a fully automatic mode, a semi-automatic ("joy-stick") mode or a manual mode. Displays and controls are provided on a console in the wheelhouse; a smaller console in the drillmaster's cabin provides control of some functions.

Drilling equipment

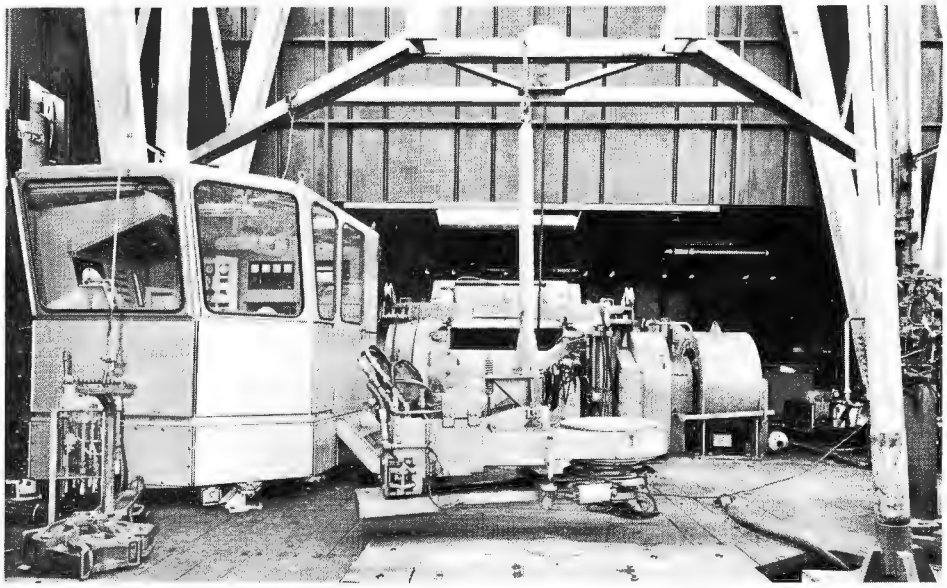


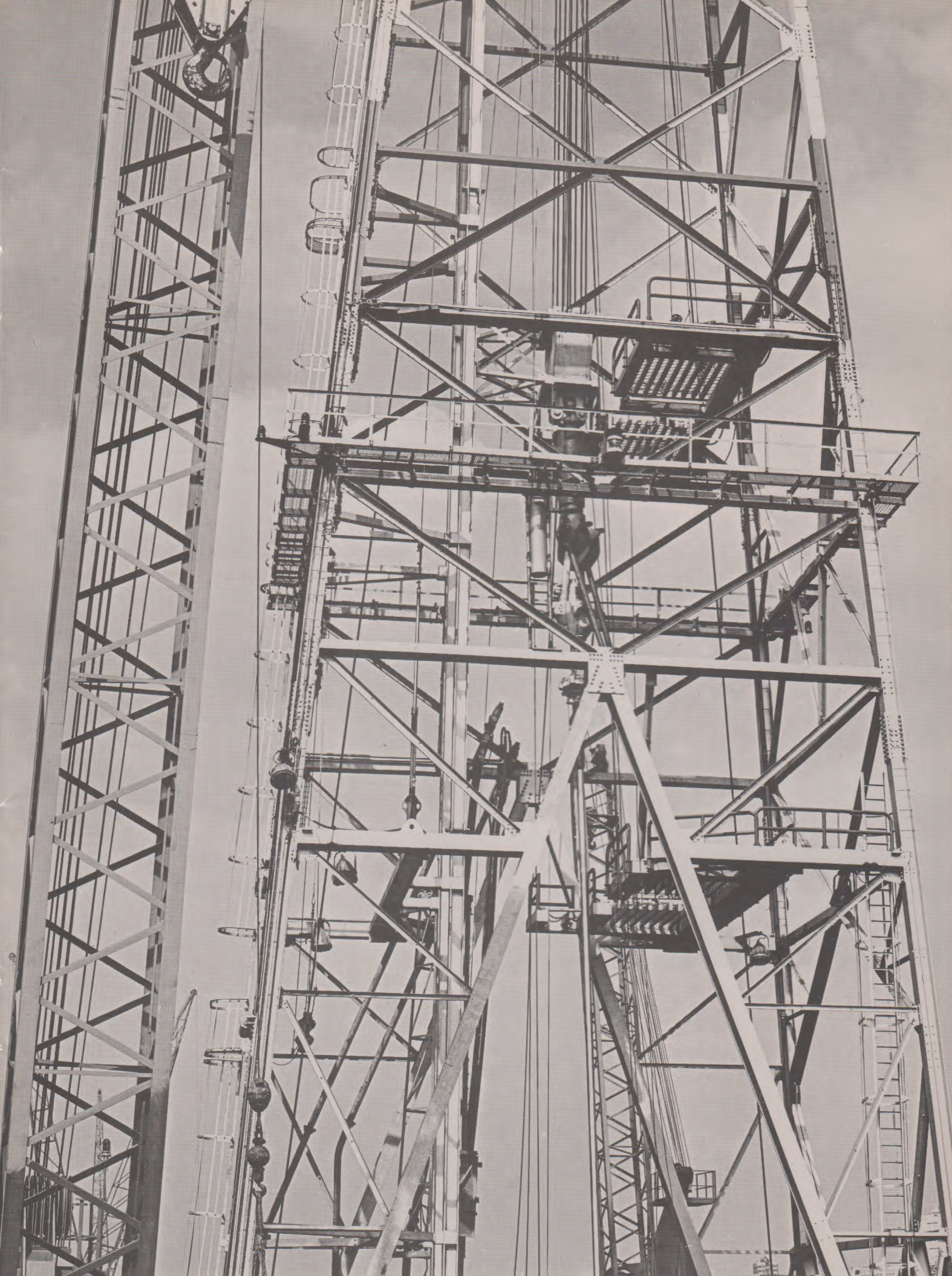
1. Derrick and drilling floor

A heavy substructure supports:

- a 147 ft Pyramid derrick of special design which is matched to the hull construction, the racking system and the heave compensating device. The API capacity is 635 tons (1,400,000 lbs). Dynamic conditions have been considered.
- a National 1625 DE drawworks with a 1,600/2,400 hp electric drive
- a complement of National equipment of the heaviest capability: independent rotary (37½" opening), crown block (7 x 60" sheaves of special pattern), travelling block, swivel, etc.
- the Byron-Jackson hook, power tong and tong adjustment pedestal which constitute a functional part of the automatic racking system.
- the racking system machinery and structures
- the riser tensioner system
- the drilling master's cabin
- various manifolds and implements.

The strength of the substructure is adequate for the static and dynamic stresses exerted by the drilling equipment, drill pipes, casing pipes, riser pipes, etc. The drilling floor is raised 7.5 m (24 ft) above the main deck level.



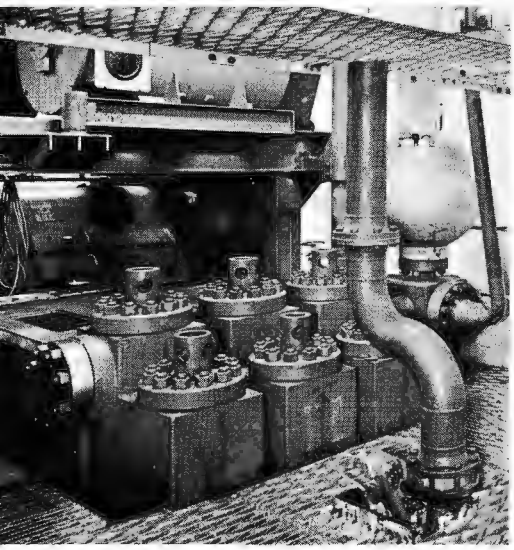


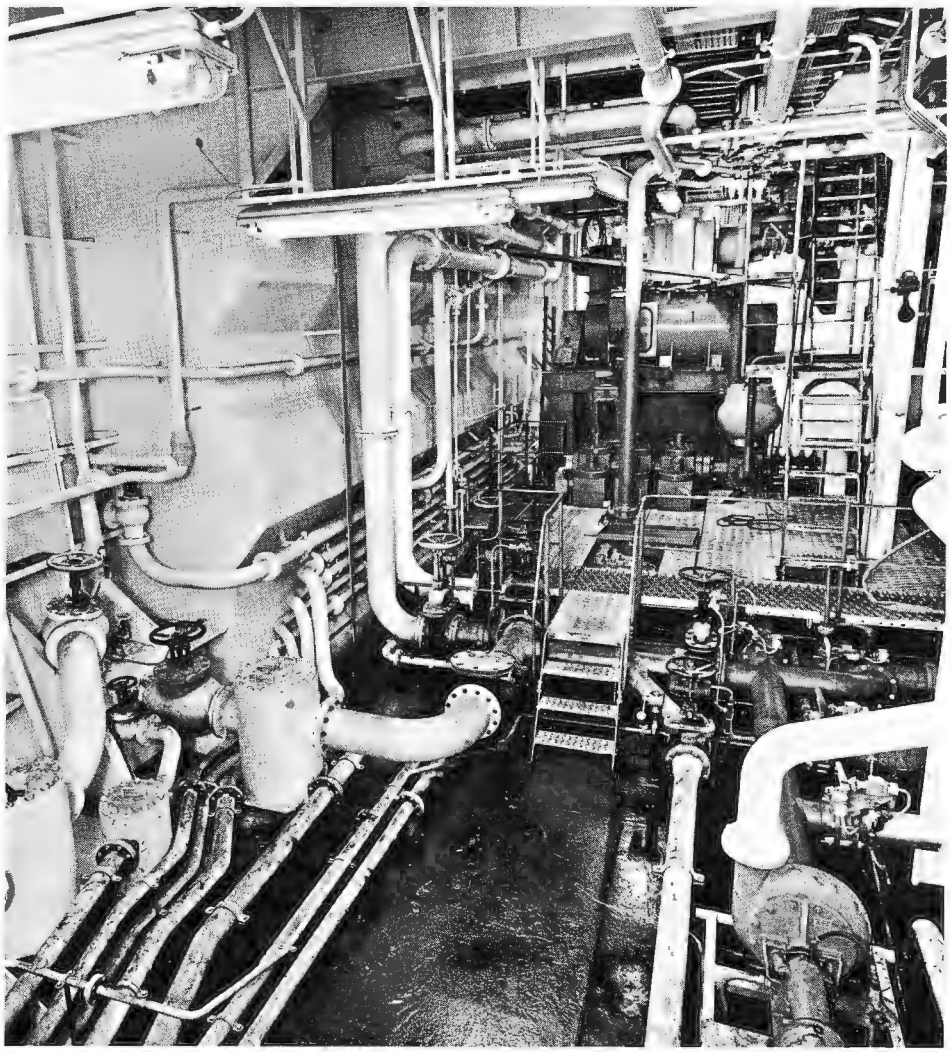
2. Mud pumps and tanks

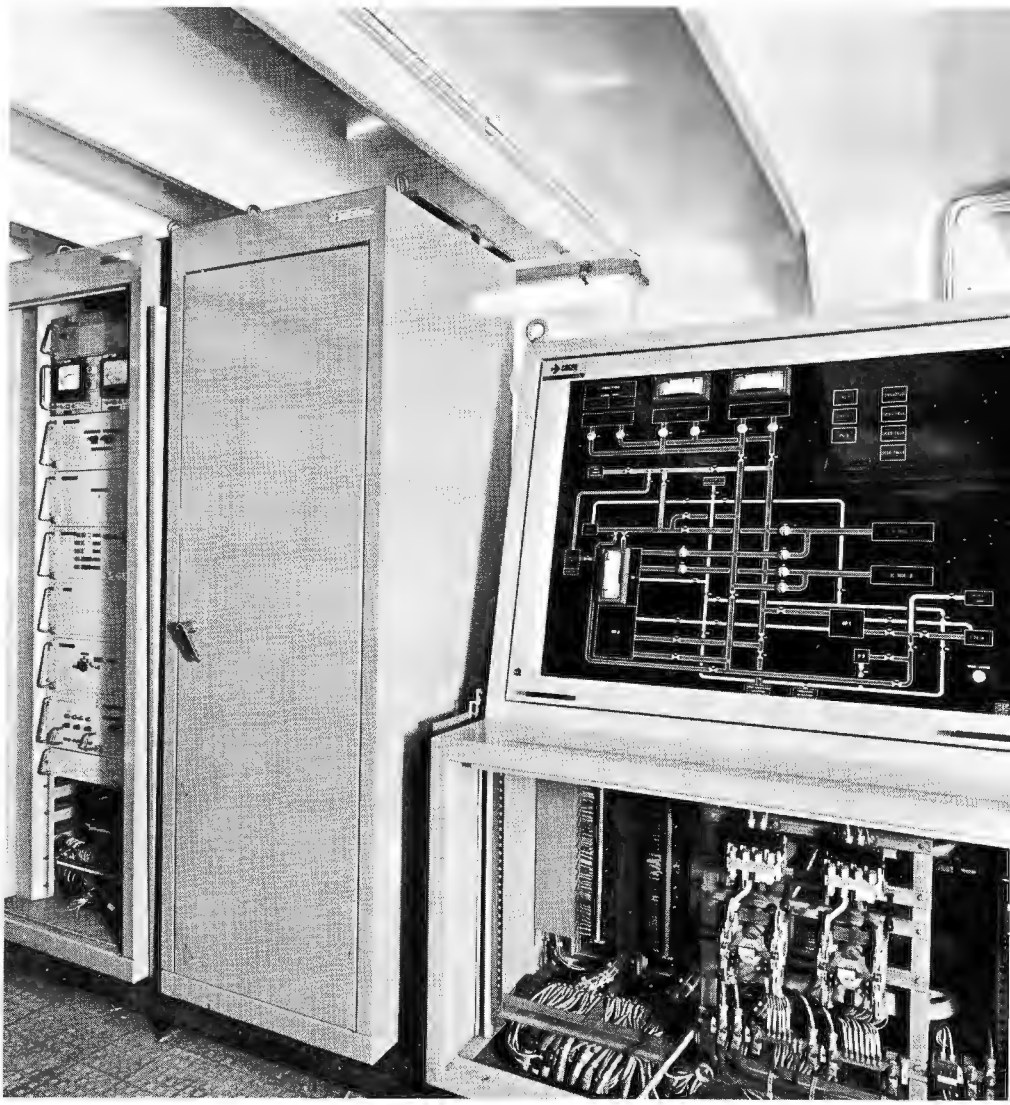
Two 1,600 hp National 12P-160 triplex pumps, a complete Dowell-Schlumberger R 708-J cementing unit and two 6″ x 8″ Mission centrifugal mud transfer units are located in the mud pump room.

Three circulating mud tanks are situated on the main deck. They are equipped with mud processing machinery: double deck shale shakers, two sets of cyclone desanders, one battery of cyclone desilters, degasser, mixers, etc.

Three additional 6″ x 8″ Mission centrifugal pumps feed the cyclone-type separators.

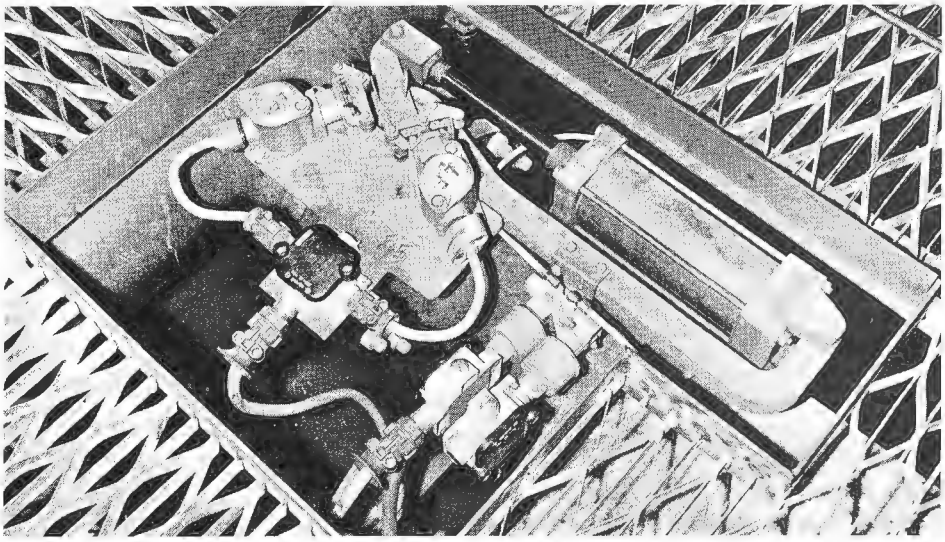






Two storage and mixing tanks are built into the mud pump room. The capacity of the circulating mud tank is 143 m^3 (900 bbls) and that of the storage and mixing tanks 125 m^3 (800 bbls). One 50 m^3 (315 bbls) storage tank can be used for mud circulation.

All suction (10″ and 8″), transfer (6″ and 4″) and discharge (6″-5,500 psi and 2½″-10,000 psi) mud lines are controlled from the drilling master's cabin or the mud laboratory. The remote controls of the bulk mud and cement pneumatic transporter are located in the mud laboratory.



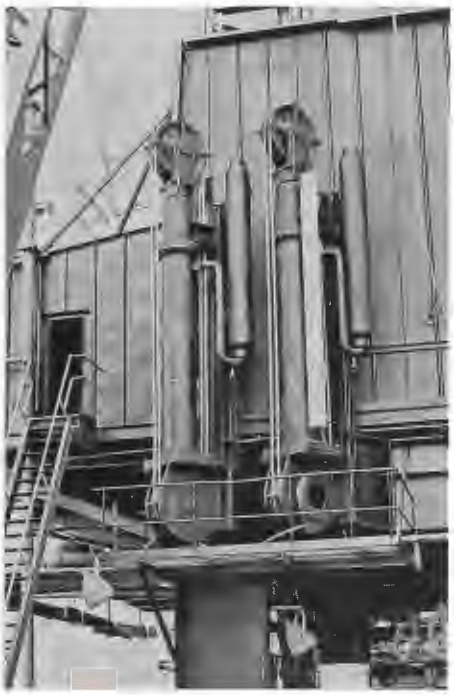
3. Riser tensioning equipment

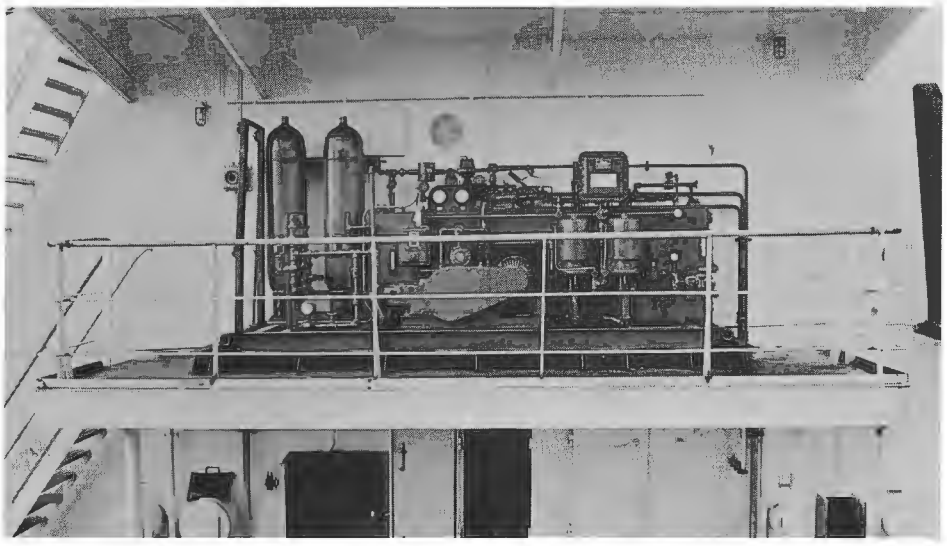
The wires supporting the riser pipes are connected to 6 IHC-built swell compensators, which are attached to the drilling substructure. The tension is regulated by a hydro-pneumatic system.

Each of the 6 units has the following characteristics:

- maximum tension: 31 tons (68,000 lbs)
- maximum stroke: 12 m (40 ft)
- tension variation: 3 per cent (12 ft heave/6 sec)

A control console is located in the drillmaster's cabin. The main operating panel is located close to the drilling well with access from the BOP floor under the substructure.





4. BOP controls

The Koomey BOP controls are of the electro-hydraulic type.

The pumps and manifolds are located at the rear of the forward superstructure.

The main control cabinet and the two remote control cabinets are situated on the drilling floor and in the tool pusher's office, respectively.
The cable-active reels, which have a capacity of 420 m (1,400 ft) are situated beneath the drawworks on the main deck.

The main accumulator is mounted on the BOP stacks (20″-3,000 psi and 13 5/8″-10,000 psi). The kill and choke lines are connected to a 3 choke, 10,000 psi WP manifold.

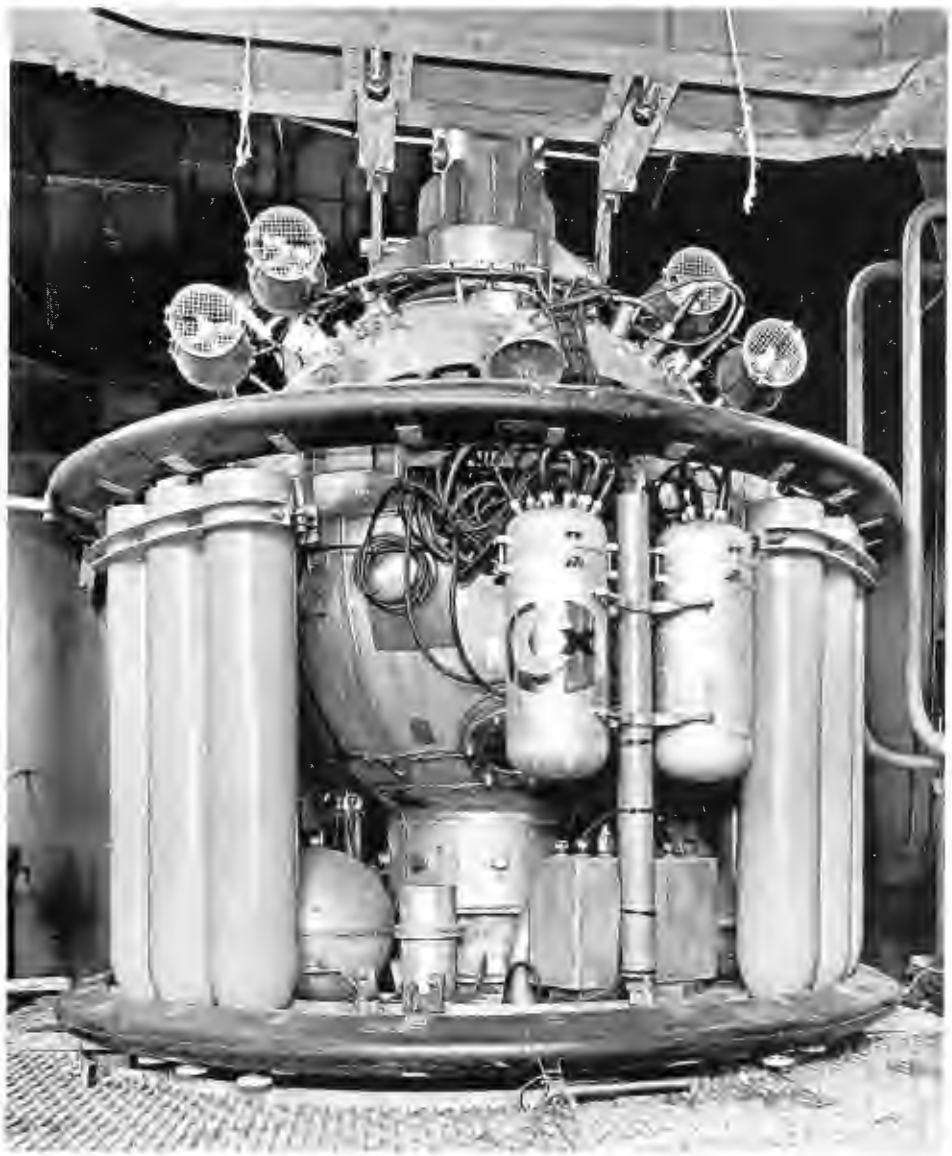
Special equipment

1. Deep diving installation

This CG Doris/Comex installation allows for long saturation diving by six men down to 300 m (1,000 ft).

The main components are:

- deep diving bell and guiding devices
- decompression chamber
- bell handling hoist and clamps
- gas compression, mixing and regenerating complex
- gas and parts storage areas
- diving operation control rooms

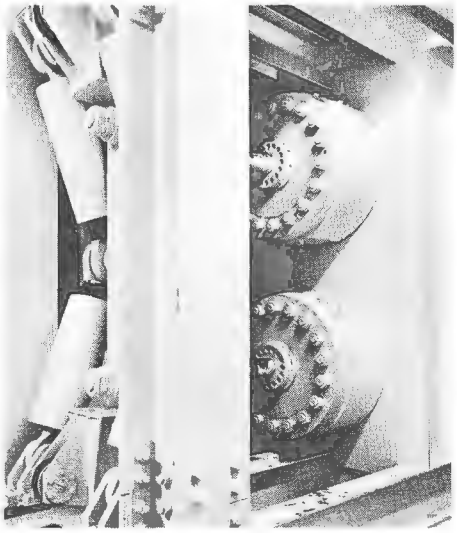


2. Drillmaster's cabin and instruments

An enclosed cabin capable of being rotated accommodates the necessary controls for:

- drilling equipment and DC motors
- drilling measurement and manifolds
- riser tensioners and heave compensator
- BOP and well control valves
- ship behaviour and dynamic positioning
- underwater television

The measuring instruments have been redesigned and incorporate a continuous rate of penetration indicator. The main data (10) are recorded.



3. Heave compensating device

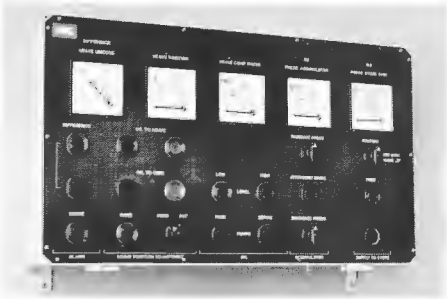
This is of IHC Holland design, producing the heave compensation by vertical adjustment of the derrick crown block.
The hydraulic jacking system is controlled by a patented IHC Unicode device with the following characteristics:

- maximum load: 200 tons (440,000 lbs)
- maximum stroke: 4.57 m (15 ft)
- Force variation over full stroke: 3 percent static or 5-6 percent dynamic

The system is controlled from a panel in the drillmaster's cabin.

The first drilling operations were completed successfully, largely in severe weather conditions, in the North Sea, 110 miles east of the Shetlands.

The dynamic positioning system of the "Pélican" operated within an accuracy of about 2% of the water depth of 400 ft, in winds of 45 knots and waves of 15 ft.

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