International Hydrographic Review, Monaco, LXII (1), January 1985

THE "MITRA", A NEW SURVEY VESSEL FOR THE NORTH SEA

by Frans A. van DONGEN(*)

This paper was originally presented at "Oceanology International", March 1984, Brighton, U.K. and is reproduced with the kind permission of the Organizers, Spearhead Exhibitions Ltd., U.K.

INTRODUCTION

On the 2nd of July 1982 the Dutch Department of Transport and Public Works (Rijkswaterstaat) commissioned the new survey vessel *Mitra* for work in the North Sea.

The 57-metre-long ship is employed for research into the hydrography, geology and soil mechanics of the sea-bed, and for performing underwater inspection work on the Dutch continental shelf. In addition to these tasks the vessel can be used for clearing oil spillages.

The *Mitra* is in many ways unique as a survey vessel. She is equipped with a number of advanced electronic instruments, heavy lifting equipment, a moonpool and a dynamic positioning system. She was designed by Damen Shipyards B.V. in Gorinchem and built at their Frisian shipyard in Bergum.

The *Mitra* was built because more vessels were urgently needed to collect data on the oceanography and marine geology of the North Sea. A greater knowledge and understanding of marine phenomena is required, partly because the North Sea is increasingly being used by shipping and for offshore mining, and partly because plans for land reclamation, building artificial islands and the fight against marine pollution depend upon such knowledge. It is the job of the Rijkswaterstaat North Sea Directorate to coordinate and carry out the research necessary for effective management of the North Sea and prudent exploitation of North Sea resources. For this purpose it operates a fleet of six ships and one aircraft.

The *Mitra*'s assignments include surveying, inspection and research. More specifically, this means that she is used for : making detailed surveys of shipping

(*) North Sea Directorate, Rijkswaterstaat, P.O. Box 5807, 2280 HV RIJSWIJK (ZH), The Netherlands.

lanes, checking dredging work, underwater pipeline inspections, wreck investigations and locating cargo washed overboard from freighters or debris which may endanger the environment or the users of the sea. Regular use is made of the vessel for geological research into : the distribution of sands and gravels, the dynamics of sandwaves, the Quaternary stratigraphy and geotechnical properties of the upper few metres of the sea floor. In addition, the ship can be used for clearing oil spillages.

The specialized instruments and equipment for all of these activities can be divided into : the survey system, the dynamic positioning system, the hoisting equipment and the oil-spill clearing apparatus. Firstly, and before dealing with the systems and equipment in detail, the main design considerations of the *Mitra* should be mentioned.

Conception, design and construction

The North Sea Directorate required the following elements to be incorporated in the design :

a) a large working deck area aft (approx. 200 square metres) with enough space for hoisting gear, containers and ancillary equipment;

b) accommodation for 22 people, preferably in single cabins, combined with a sizeable area for scientific work and a wet laboratory;

c) the lowest possible noise levels in both the living quarters and work areas;

d) a high standard of stability, even in rough seas, to make working conditions for both the crew and scientists easier and more pleasant;

e) a simple and effective method of maintaining the ship's position without anchors;

f) means of maintaining a set course even at a minimum speed of 2 knots;

g) a moonpool of approx. 4 × 4 metres, located at the centre line amidships where the motion amplitude of the vessel is at a minimum;

h) a semi-enclosed work area around the moonpool with access to a large equipment storage area below the main deck.

Specialists from the shipyard worked in close cooperation with staff members from both the Vessels Department of the Ministry of Transport and Public Works and the North Sea Directorate on the design and building of the *Mitra*. As a consequence of this cooperation and considering the ship's dimensions and her special features and equipment, the construction costs were relatively low. Costs were kept within the limits by operating with a fixed budget from the start. The clients took joint responsibility for the ship's performance, deciding technical matters in consultation with the shipyard.

Accommodation and work areas

As far as accommodation is concerned, it was finally decided to install 12 single and 5 double cabins.

The vessel is generally at sea continuously from 8 a.m. on Mondays till 6 p.m. on Fridays and usually carries a crew of nine as well as four surveyors. For certain surveys this number may be complemented by specialists from governmental department bodies or from the offshore industry.

The accommodation areas include two survey rooms, one in the wheelhouse and the other on the main deck immediately forward of the semi-enclosed deck area.

The laboratory below deck is joined to the after deck by a conduit for cables and hoses. A hatch in the deck gives access to large storage space below.

Engines

With the two 500-hp main engines and the 425-hp thrust of the azimuthal propeller, the *Mitra* has a maximum speed of 12.2 knots.

Without the main engines, the azimuthal propeller can be used on its own in the so-called "creep" mode to steam very slowly and quietly at between two and four knots. The azimuth propeller can also be used sideways together with the diesel-electric bow thruster for dynamic positioning. All four propellers have variable pitch control. The pitch of each propeller can be adjusted from individual controls, with the joystick, or by the dynamic positioning computer.

Electric plant

Electric power is supplied by three identical, fully automatic 180 kW 380/220-volt, 50-Hz generators. The measuring instruments run off a separate 220-volt AC system, which is fed through a 25-kW dynamic stabiliser unit capable of maintaining a voltage of 220 V with 5 % variation and a frequency of 50 Hz with only 1 % variation.

The survey system

The surveying and recording system consists of the following permanently installed instruments :

a) Atlas Deso 20 echo sounder;

b) Decca HiFix-6 positioning system with reserve receivers;

c) Datawell Hippy 120 heave compensator, to determine and correct deviations in measurement due to the ship's movement;

d) Decca Autocarta II automatic sounding system, to record positioning and depth on magnetic tape, so that the results can be converted into depth charts, profiles etc., on shore.

These together with a track plotter are linked to the survey computer that forms the heart of the surveying system. The ship can also be equipped with the following portable instruments, which are also used on other survey vessels belonging to the North Sea Directorate :

a) EG&G side-scan sonar system;
b) EG&G sea-floor mapping system;
c) EG&G boomer sub-bottom profiling system;
d) O.R.E. sub-bottom profiling system;
e) Osprey underwater colour video system, operated by divers;
f) A Westmar scanning sonar;
g) Rockleng air hammer corer;
h) An in-situ quasi static cone penetrometer.

The survey system can be connected to the automatic pilot/gyro equipment, which steers the ship and automatically keeps her on a predetermined course. The information from the survey system makes it possible for the *Mitra* to keep on track without a helmsman. This is called the "autosail mode". In this mode the ship is driven by the main propellers. This differs from the so-called "autotrack" mode when the azimuth propeller and bow thruster are employed.

The dynamic positioning system

With a computer-controlled dynamic positioning system that can engage all four propellers independently, the vessel can be maintained on position very accurately or manœuvre in any direction on any course.

The computer model of the ship's performance is continually updated with observations on wind speed and direction, wave size from the wave compensator, and the ship's position and course from the radio positioning system, or the taut-wire system, and from the gyro.

An increasing number of supply ships and diving support vessels are being equipped with a D.P. system. As far as it is known the *Mitra* is the first survey vessel to be fitted with such a system.

The dynamic-positioning system can be used in two modes. The first is the *stationary mode,* where the vessel stays in position within an approximately two-metre radius circle, and the second is the *autotrack mode,* where the vessel follows a chosen course with a different heading at a maximum speed of four knots.

The stationary mode is adopted for drilling, diving, taking samples and installing and recovering instruments. The great advantage of this system is that time does not have to be spent on anchoring and the ship position is unaffected by wind or tidal currents. It also enables the ship to leave position immediately should the danger of collision arise. In the autotrack mode the vessel has exceptional manœuvrability. This enables entirely new measuring techniques to be used for investigating the sea bed with sonar and television cameras. It is extremely valuable when a remotely operated vehicle (R.O.V.) is being used to examine pipelines and wrecks and to detect and identify objects.

The vessel can keep position or move very slowly along with the R.O.V. and yet remain completely under control so that every inch of the sea-bed can be systematically explored and inspected in detail.

Hoisting equipment

The *Mitra* is equipped with three main cranes and three small electric davits.

A 10-ton hydraulic crane with a 14 m reach is mounted on the starboard side midway along the main deck. A 5 ton-capacity A-frame is located across the stern and a 50-ton gantry crane is stationed above the moonpool. The hydraulic crane and A-frame cover the whole free deck space.

The over-8m-high gantry crane rides on rails and can move to and fro along the deck. This makes it exceptionally easy to hoist heavy equipment from the deck and then position it above the moonpool where it can be lowered to the sea-bed.

Oil-spillage clearance equipment

Engineers from the North Sea Directorate take the view that, where possible, operations involving the clearing of oil spillages should be combined with other tasks. The idea is to avoid maintaining expensive ships solely for the purpose of clearing oil slicks. Such ships would in the main lie idle in port.

Like the rest of the Directorate's ships, therefore, the *Mitra* is equipped to play a supporting role in the event of oil spillages. For this purpose, she is permanently equipped with two extendable spraying-booms to spray the oil with chemicals. The oil is dissolved into droplets that can be more effectively broken down by micro-organisms.

The *Mitra* also has a 13-metre long sweeping arm that can be used to collect as much oil as possible from the water surface.

From an environmental point of view this is the preferred method for clearing oil slicks. To save deck space, the sweeping arm is normally stored on shore. The *Mitra* has a storage capacity of 240 cubic metres for the mixture collected.

Special features

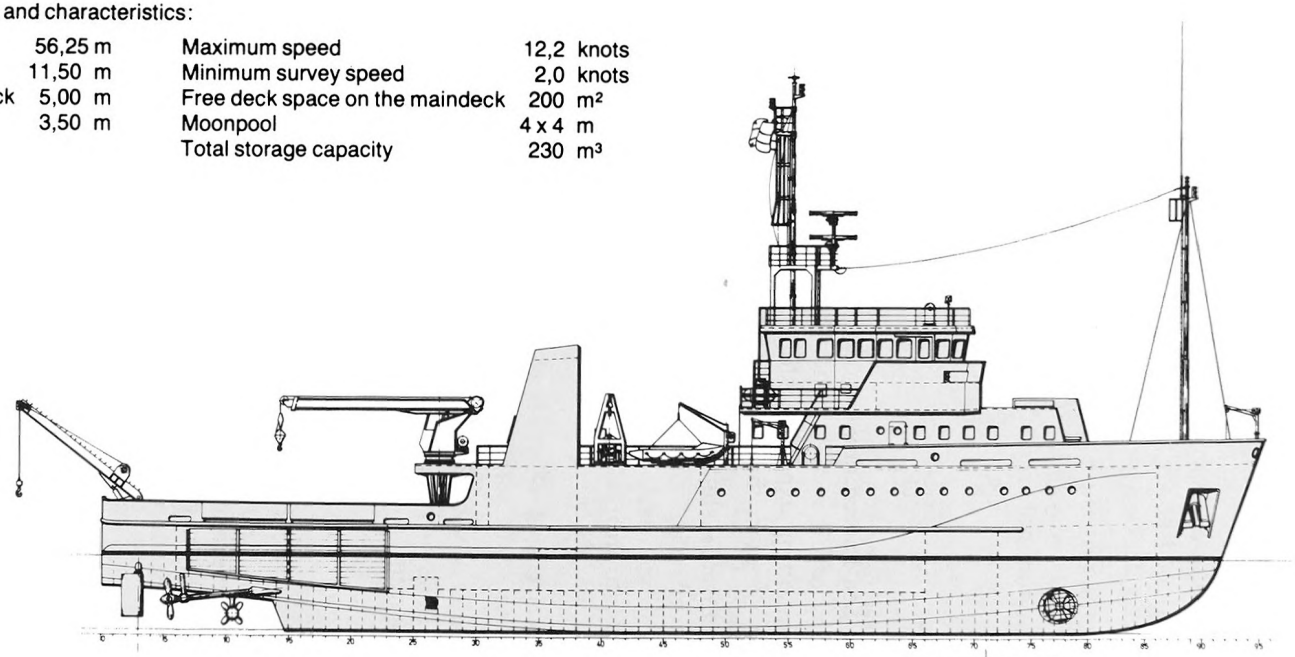
The combination of a comprehensive survey system, a moonpool, the dynamic positioning system, different propulsion options and hoisting facilities adds a number of new survey procedures to the traditional ones.

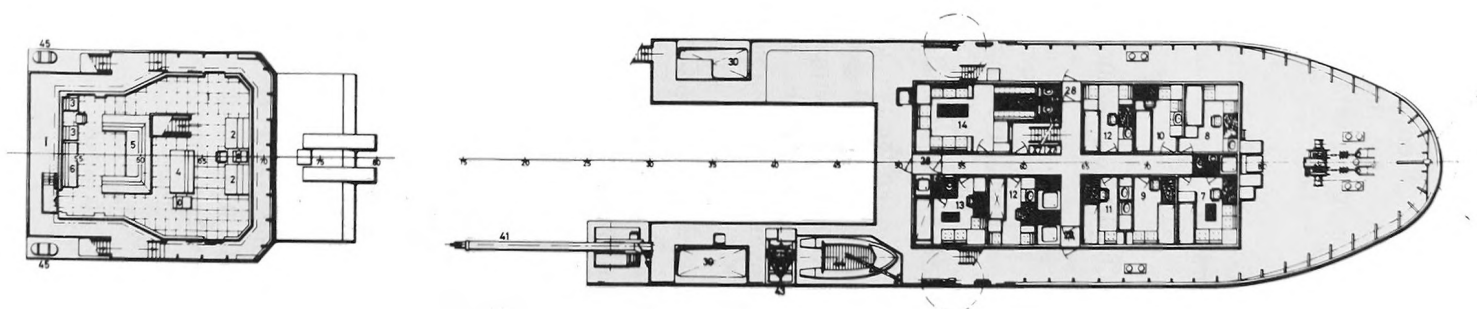
In the first place the techniques of *Sea-floor Mapping* can be fully exploited. Using the EG&G sea-floor mapping system and by steaming very slowly with the azimuth propeller in creep mode, high quality sonographs can be made. The sea-floor mapping system is a side-scan sonar system that automatically makes corrections for slant/range and changes in ship's speed.

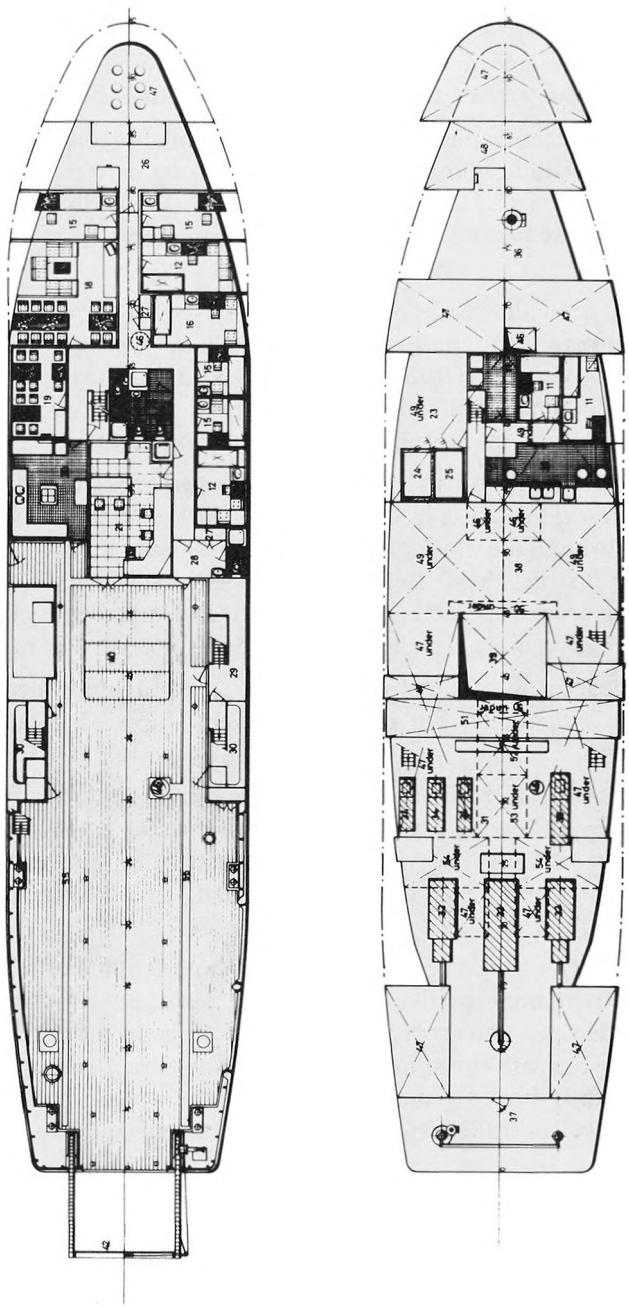
It gives a sonar recording which is linear in both x and y direction, so that the distortion inherent in sonographs made using normal side-scan sonar is eliminated. This allows a very detailed picture of the sea-bed topography and objects on it to be made. Orientation and dimensions of sonar contacts can be measured directly on the recording. Due to the very low velocity of the vessel the discrimination of these sonar recordings is very high. Objects of less than one metre

Main dimensions and characteristics:

Length overall	56,25 m	Maximum speed	12,2 knots
Beam moulded	11,50 m	Minimum survey speed	2,0 knots
Depth to maindeck	5,00 m	Free deck space on the maindeck	200 m²
Working draft	3,50 m	Moonpool	4 x 4 m
		Total storage capacity	230 m³







General arrangement of the "*Mitra*"