On the New Antarctic Research Ship FUJI

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新南極観測船「ふじ」について

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要　旨

本年から南極観測が再開されることに決まり，「宗谷」の代船として南極観測船「ふじ」が建造されることになった．「ふじ」は日本最初の本格的極地用砕氷船であって，南極における輸送，砕氷，観測の任務に従事するものである．

船の寸法，船型等は主として砕氷船としての性能から決められ，それに大型ヘリコプター3機を搭載して大きな空輸能力を有することが特徴である．推進機関はディーゼル電気推進方式を採用し，氷海中での行動能力の増大を狙っている．長期行動に備え居住性向上には特に意を用い，更に，減揺タンクを設けて航行中の船上作業に便ならしめている．船体構造は氷圧力に対し極めて強固に設計された．船上観測設備は11科学部門に渉っている．

Introduction

The FUJI left Tokyo on November 20, 1965 to accomplish her first misson to the Antarctic.

It was in August 1963 that the Japanese Government had decided to reorganize the Japanese Antarctic Research Expedition and to build a new research ship replacing the SÔYA. The M. S. SÔYA, a converted lighthouse tender belonging to the Maritime Safety Agency, was employed 6 times for this purpose; however, she is now too old to accomplish various services against heavy ice of the Antarctic.

The new ship is the first regular antarctic expedition ship in Japan. The design was carefully proceeded, based on valuable experiences of the SÔYA. The ship was launched in March 1965 and was named FUJI.

Mission

The FUJI is a multi-purpose ship. Her first mission is the transportation of 35

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scientists, instruments and consumables between the mainland and the antarctic scientific station "Syowa", the second is ice-breaking for the purpose of transportation, and the third is research and investigation while navigating to and from Antarctica.

Principal particulars

Length overall	(m)	100.00
Breadth max.	(m)	20.00
Depth moulded	(m)	11.80
Draft	(m)	8.10
Displacement normal	(t)	7,760
Speed in open water	(kt)	approx. 17
Endurance	(kt × s.m.)	15×15,000
Machinery		Diesel-electric
Shaft horse power		11,900
Numbers of shaft		2
Complement		235
Builder		Tsurumi Shipyard, Nippon Kokan Co.
Keel laid		28 Aug. 1964
Launch		18 Mar. 1965
Completion		15 July 1965

The choise of principal dimensions and their ratios were primarily governed by the requirement in building an ice-breaker. Secondarily, they were limited by considerations of the space required for helicopters, laboratories, hold, power, machinery space in double hull and others.

The shaft horse power was determined on the basis of the required power to sustain maximum speed for free running, navigation speed for 2 generators running, and maximum thrust in ice-breaking operation. In the third place, power as large as possible would be desirable; however, it is noticed that the larger the power the more massive must be the ship, in order to guarantee more space to put powerful engines, fuel tanks and additional personnel. Thus, the final compromise led to adopt 11,900 SHP.

Arrangement

Schematic arrangement plan is given in Figs. 2–3. There are three continuous decks, an extended forecastle, and a large deck house on the main deck amidships. The upper part of the hull, over one half length after part, is used as the flight deck, the helicopter hangar, the aviation stores and shops. A considerable portion

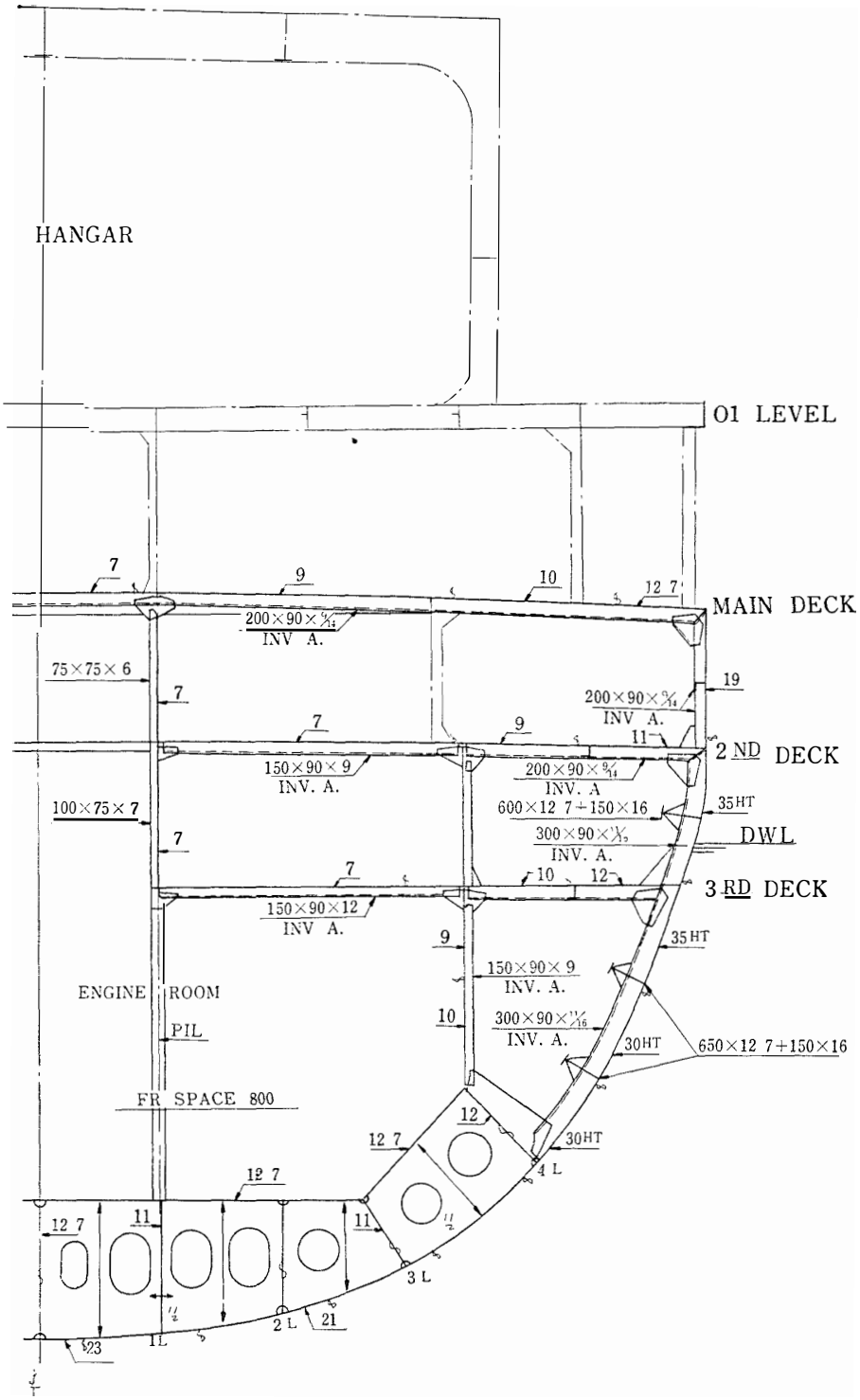


Fig. 2. Midship section.

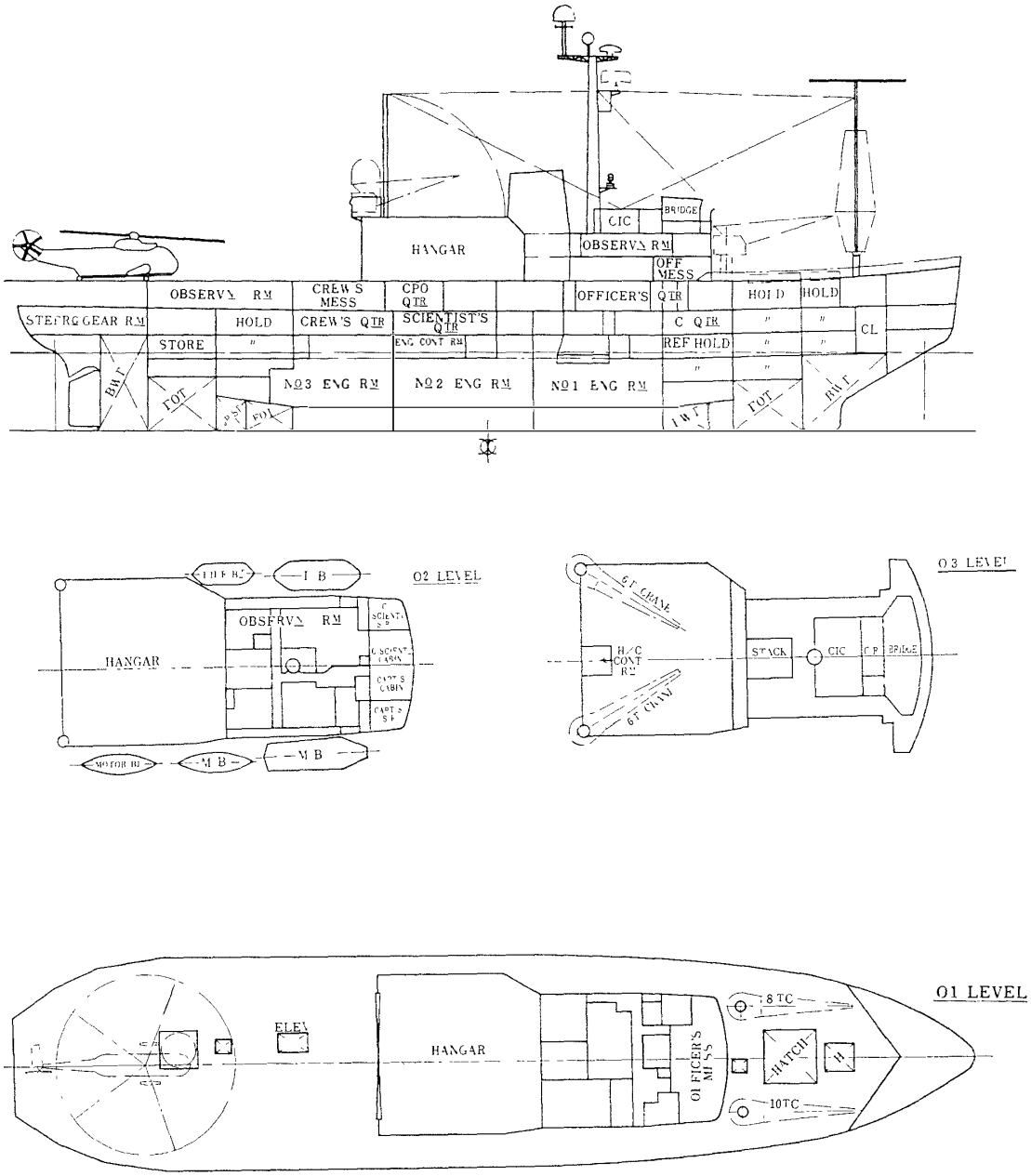
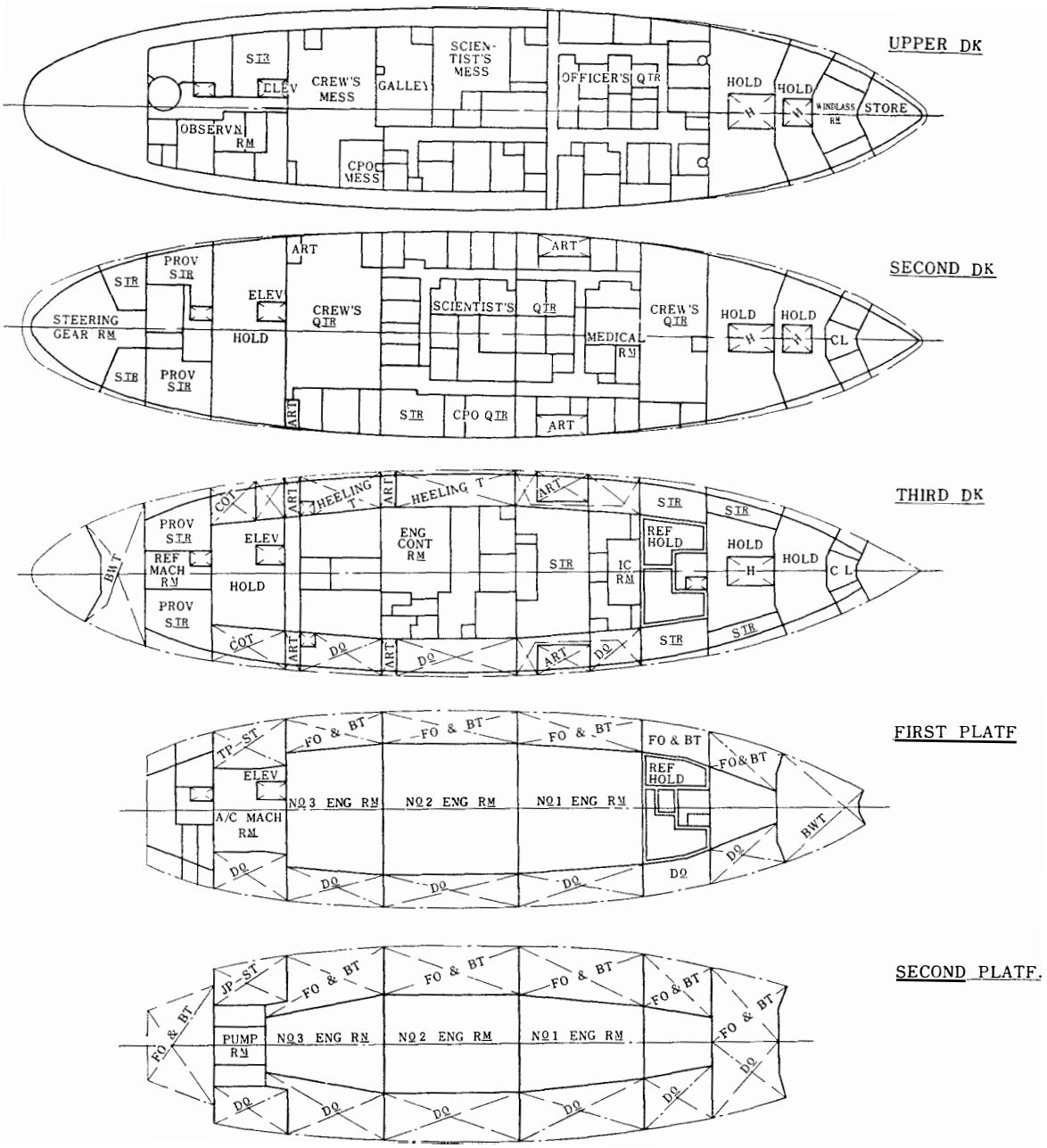


Fig. 3. General



arrangement.

in the main hull is occupied by three engine compartments. Moreover, there are four holds and many stores in fore and aft and accommodation in two uppermost levels.

Most of the laboratories are located in bridge erection and the aft end of the deck house. The main mast is installed on the bridge, supporting radar, TACAN, crow nest, etc. One fore mast and twin foldable aft masts are for the long-range communication antennae.

Ice-breaking capability

In determining the ice-breaking capability, such factors were thoroughly considered, *i.e.*, dimensions, power, hull form, propellor, adverse ice and weather conditions in the areas around the Syowa Station in Prince Harald Coast. The hull form was designed so as to obtain the highest efficiency for operations in ice area. The fact that the FUJI is capable of boosting 13,800 SHP for one hour is a great help.

Thus, the ice-breaking capability of the FUJI is approximately equivalent to other ice breakers with the same displacement and power.

As is usual with modern ice breakers, three heeling tanks are situated amidships, on each side of the ship between the second and the main deck. By means of three pumps, 340 tons of water can be transferred from one side to the other within 90 seconds, thus creating a heel of about 5 degrees.

Subdivision

The ship is subdivided into ten watertight compartments by transverse bulkheads. Below the second deck, two longitudinal bulkheads and the inner bottom are provided almost throughout the overall length, subdividing the wing fuel tanks, fresh water tanks, heeling tanks, anti-rolling tanks from machinery spaces and cargo holds. Two floodable compartments system is carried out on this ship.

Anti-rolling device

It is desirable that ice breakers should be installed with anti-rolling device for objectionable rolling characteristics. Three pairs of anti-rolling tanks, passive "U"-tube type, with a slightly different natural period, are installed instead of bilge keels.

Maneuverability

There may arise a great difficulty in keeping the ship's required course straight

when confined in ice area. It was reported that in the case of Sôya the actual distance passed in ice area was 2.5 times of that in straight line.

Rudder is single, of a fairly large size, being 1/37th of the lateral submerged plane area. The twin screws directly controlled from the bridge are expected to give additional maneuverability.

Hull structure

The ship has been constructed in accordance with the requirements of the NK (Nippon Kaiji Kyokai) classification rules in general, and of the NV (DET NORSKE VERITAS) rules for hull strengthening as an ice breaker. The hull structure members are of all-welded construction and of heavy scantlings. The ice belt is a 30–45 millimeters thick, high tensile steel with a high impact strength even at low temperatures. The ice belt is transversely framed with a spacing of 400 millimeters.

There are also a member of web frame between transverse bulkheads, forming a strong cross-stiffened structure with side stringers and shell plates against the pressure of ice.

Equipment

Four hundred tons of such cargoes as vehicles, construction materials, stores and provisions to be used in the Antarctic are stowed in cargo holds. Four deck cranes, two 10-ton cranes in forward and two 6-ton in aft, are electrically driven; two elevators and two conveyor lifts are installed for cargo handling. Two fork lifts, one for the on-deck use, another for the on-ice use, are provided for loading to helicopters. The steering gear and the windlass are of electro-hydraulic type.

Two life boats, two moter driven launches and one ice boat, are all carried in the gravity davits.

The ship is fitted with the CO_2 fire extinguish system in cargo holds. In addition, foam fire extinguish units are provided for the helicopter landing area.

Accommodation

It is important that the accommodation should be as comfortable as possible during long cruise.

The officers are accommodated in twin berth cabins. All rooms for the scientists are almost the same as the officers', and are situated on the third deck amidships, being isolated from other quarters. Saloons are independently annexed to the bed rooms of captain and chief scientist. Special attention was paid for the comfort of complement in interior decoration and colour design. Incombustible or low

inflammable material has been used to a large extent in the accommodation to minimize the possibility of fire hazard. Air conditioning system is thoroughly equipped to facilitate the living in the antarctic and equatorial regions.

Sick bay, surgical room and dental room are occupying the middle of the third deck. The accommodation is well insulated as the ship will operate in temperatures as low as −35°C.

Aircraft

Three turbo-driven helicopters are provided for ice-reconnaissance and transportation. Hanger is capable to stow them.

Three screen doors with a width of 5 meters in the hangar are operated automatically, and two vertical screen rails also can be removed when the helicopters are transferred to the flight deck.

There are necessary equipments for heating, starting and securing helicopters.

Propulsion plant

As is the usual case with modern ice-breakers, diesel-electric propulsion system is adopted. Four diesel generators are placed in two engine rooms, two in each room; the third engine room is provided with four electric propelling motors, two in tandem to each shaft. D. C. Ward-Leonard system with G-M G-M series connection is adopted.

The FUJI can be maneuvered from five places, *i. e.*, bridge, each dodger of the bridge wing, crow nest and machinery control station which is located on the third deck above the second engine room.

Three 625 KVA diesel AC generators for auxiliary use and one 150 KVA diesel AC generator for emergency use are installed in the machinery space.

Two evaporators have a capacity of producing fresh water of 60 tons/day. There are three auxiliary boilers to produce steam for airconditioning, tank heating, cooking and other miscellaneous uses.

Propeller

Propeller is 4.8 meters in diameter, four blades, built-up type, and is made of stainless steel.

Propeller blades have an extremly heavy scantling. Enough strength was given to the blades in order to withstand the shock loads imposed by ice floe.

Scientific laboratories

Facilities on board the ship were installed to conduct researches under eleven scientific disciplines, *i. e.*, cosmic rays, ionosphere, aurora and airglow, meteorology, geology, geography, geomagnetism, gravity, seismology oceanography and biology.

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