THE NUCLEAR SHIP IN JAPAN

General

The development of the nuclear ship in Japan has been advancing steadily according to the "Long-Range Plan for Development and Employment of Atomic Energy" by THE JAPAN ATOMIC ENERGY COMMISSION. This long-range plan had been formed with the understanding that, as the world will attain the age of practical use of the nuclear ship in the 1970's, Japan should build her first nuclear ship, and should hurry up the research and improvement of high powered nuclear reactors for marine use.

To build the Japanese first nuclear ship, an official body named as The Japan Nuclear Ship Development Agency who will own the ship was firstly established in 1963. In April of 1967, the Agency submitted "The Application for Permission to install a Reactor in the First Nuclear Ship" to the Government of Japan, and obtained the permission of the Prime Minister in November of 1967 on the basis of the safety recognition by the Nuclear Reactor Safety Committee in THE JAPAN ATOMIC ENERGY COMMISSION. So the Agency proceeded to conclude a contract for building the hull of the first nuclear ship with the Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI), and also a contract for manufacturing her reactor with the Mitsubishi Atomic Power Industries Co., Ltd. (MAPI), on November 26, 1967.

The ship having the purposes of carrying special cargoes and also of training the crew and being scheduled to be laid down in the autumn of 1968 and to be completed at the end of March, 1972, should meet the requirements of the Japanese Ship Safety Law, the various laws and regulations concerning the nuclear fuel and reactor and also the provisions of the International Convention for Safety of Life at Sea, 1960. Furthermore, the ship should undergo our surveys during construction and get the classification notation "Nuclear Ship" of our Society upon the completion. Her principal particulars are shown in the table on Page 22.

Her hull and propelling installation including various conventional machineries, an auxiliary boiler, a containment vessel and secondary shieldings are going to be manufactured by the IHI, fuel elements, control rods etc. of her reactor installation by the MAPI, and her reactor primary system by the Mitsubishi Heavy Industries, Ltd. Moreover, the manufacturers of her materials or parts are very numerous and extend over various fields.

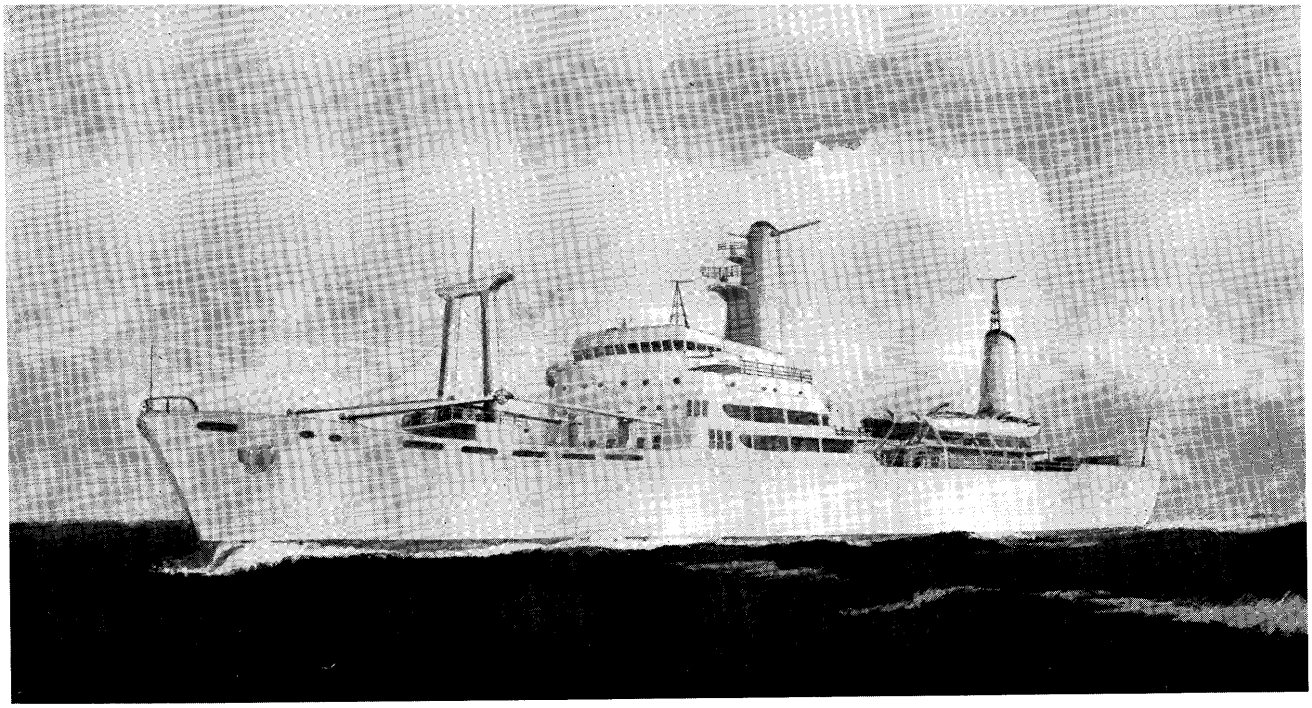
At present, her designs in details are being pushed on and the material test or approval test of welding for her containment vessel are being carried out by our Surveyors.

A few of the characteristics of her design are as described below.

Features of Her Hull Construction

She is designed to install the reactor in the reactor compartment in her midship just before the engine room.

The both sides of the compartment in which the reactor is installed are



The First Nuclear Ship in Japan (Imaginary picture on her completion)

double hull construction having within the longitudinal bulkheads and five-storied decks as collision protection, and the double bottom in the reactor compartment has also enough height so as to be safe for stranding.

Moreover, her hull is designed to be subdivided into 10 water tight compartments and to be capable of being afloat when any two adjacent compartments are flooded.

Her Reactor Installation

The main part of the reactor installation equipped in her midship consists of the reactor vessel which is set in a huge steel container of 10 meters inside diameter and 10.6 meters inside height, the controlling devices for the reactor, main steam generators, a pressurizer, primary pumps and pipes etc.

The heat of primary system generated in the reactor core is transmitted to water of secondary system in the main steam generators, and generate the saturated steam of about 40 Kg/cm^2, 251°C which is led to the main steam turbine to drive it.

The reactor core, contained in the steel pressure vessel of a cylindrical type, consists of 32 pieces of fuel assembly consisting of the fuel elements and burnable poison elements. The fuel element is low enriched UO_2 pellets packed in an austenite stainless steel theathe and the burnable poison element is the solid poison consisting of zircoloy in which boron-carbides are dispersed and being packed in a theathe as above. Its fuel inventory is equal to 2.5 tons of low enriched uran. of two regions.

The 12 pieces of control rods are the groups of stainless theathe packed with silber, indium and cadmium alloy and are arranged and fixed in cross-wise. These rods driven by the rack and pinion type drive mechanisms from the upper part of the reactor, are inserted among the fuel assemblies and, in emergency, will be deeply inserted into the core by the action of scram springs. Furthermore, there will be installed the boric acid injection system to inject the boric acid into the reactor vessel for the purpose of leading the reactor in warm shutdown condition to cold shutdown condition if it becomes impossible to insert a part of the control rods.

As cooling system, there are installed two circuits for primary system going to the steam generators from the reactor, and a circuit for secondary system going to a propulsional turbine or generator's turbines. And, for the decay

heat removal in cases of marine disasters, careful consideration is given.

In addition to the above, there will be installed the radioactive waste treatment system, radiation control equipment etc. necessary for the reactor installation.

Principal Particulars of The First Nuclear Ship in Japan

a) General

Purpose : Nuclear Powered Experimental Ship for carrying Special Cargoes and training the Crew.
Classification : NK – NS* (Nuclear Ship), MNS*
Type of Ship : Flush Deck Type.
Length (p. p.) : 116.00 m.
Breadth (mld.) : 19.00 m.
Depth (mld.) : 13.20 m.
Draft (design) : 6.90 m.
Gross Tonnage : About 8,350 tons.
Deadweight : 〃 2,400 tons.
Sea Speed : 〃 16.5 knots. (When the Auxiliary Boiler is used - about 10.0 knots)
Service Area : Ocean-going.
Complemen : 79 Persons including 20 Researchers.

b) Propulsional Plant

Main Engine : Steam Turbine (Cross Compound Type with Double Reduction Gears)×1 set.
Max. Continuous Power 10,000 SHP×200 RPM.
Nominal Power 9,000 SHP×193 RPM.
Auxiliary Boiler : Two-drum Oil Burning Water Tube Boiler×1 set.
Steam Pressure 30.0 Kgs/cm² Saturated.
Max. Evaporation 18.0 tons/hr.

c) Electric Generators

Main Generator : Steam Turbine Driven A. C. 1,000 kVA×2 sets.
Auxiliary Generator : Diesel Engine Driven A. C. 900 kVA×2 sets.
Emergency Generator : Diesel Engine Driven A. C. 300 kVA×1 set.

d) Reactor

Type : Pressurized Water Reactor×1 set.
Thermal Output : 36 MW.
Core : Low Enriched Uran. Two Regions. (Outside 4.4% and Inside 3.2% Enriched)
Cooling Water for Primary System : 1,800 tons/hr×110 Kgs/cm²×$\frac{285°C \text{ at Outlet}}{217°C \text{ at Inlet}}$
Steam of Secondary System : About 60 tons/hr×40 Kgs/cm²×251°C at Full Loaded Condition.
Reactor Vessel : Vertical, Cylindrical Type×1 set. (1,750 mmϕ×5,651 mmH)
Steam Generator : Shell and Tube Type×2 sets.
Evaporating Capacity 30 tons/hr/1 set.