

## Building the 5th Generation Ramform Titan-class Seismic Vessel



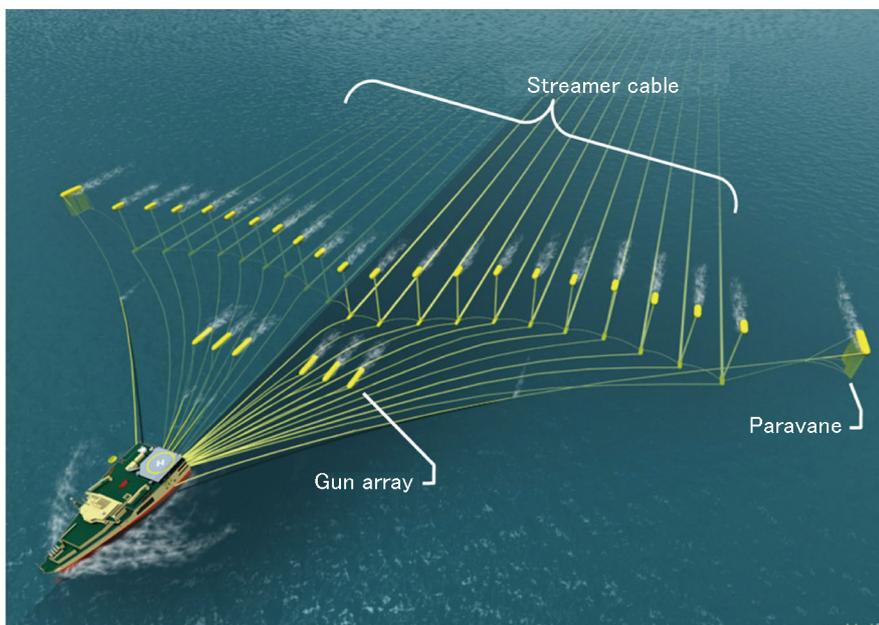
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Global primary energy demand has been increasing year by year, and exploration markets of main energy sources (oil and natural gas) continue to expand. Petroleum Geo-Services ASA (PGS), which is a major natural resource survey company in Norway specializing in offshore oil and gas fields, have developed and built uniquely-shaped seismic vessels called Ramform in Europe, and has operated the fleet to gather geological data correctly and efficiently. Mitsubishi Heavy Industries, Ltd. had received an order to build 2 Ramform vessels from PGS and has recently delivered the first vessel, which will form the state-of-the-art 5th generation Ramform Titan-class fleet. This report outlines these vessels.

### 1. General description of seismic survey

Seismic survey is a form of geophysical prospecting method to collect and analyze information on geological structures and properties underground by releasing acoustic waves (also referred to as seismic waves) into the underground and receiving reflected or refracted waves traveling back from discontinuous geological layers. For example, seismic survey is used to detect oil or gas deposits.

Seismic vessels tow both air sources that release seismic waves and streamers that have hydrophones (receivers) embedded at a regular interval. The hydrophones receive both the reflection waves from beneath the seabed and GPS data, simultaneously. Towing several streamers in parallel enables a 3D survey by gathering stereographic geological data beneath the seabed. **Figure 1** is a schematic view of 3D seismic survey.



**Figure 1** Schematic view of 3D seismic survey

## 2. Features of the Ramform Titan-class

**Table 1** and **Figure 2** are the principal particulars and appearance of the Titan-class, respectively. This version of the Ramform provides significantly denser streamer spreads than the previous fleet because it has a broader breadth and more streamers.

This version of the Ramform has the following features.

**Table1 Main specifications of the Titan-class Ramform**

Registry	Bahamas
Vessel Classification	DNV +1A1, SPS, ICE C, E0, HELDK, RP, CLEAN DESIGN, TMON, BIS, NAUT-OSV(A), VIBR, COMF-C(3)V(3)
Length	About 104.2 m
Breadth	70.00 m
Full draft in summer	6.42 m
Transit and towing speed	About 15.5 and 5.0 knots
Propulsion type	Electric, triple CP propeller plant with nozzle and propeller shaft, total 3 x 6,000 kW
Engine plant	6 x 3,840 kW
Bow thruster	1 x 2,200 kW
Accommodations	80 persons (60 single and 10 double cabins)



**Figure 2 As-built drawing of the Titan-class Ramform**

### 2.1 Ramform hull

The greater number of longer streamers that receive seismic waves enables a wider field survey in a single operation. PGS has used Ramform hull forms, with each hull widest at the aft end section, since the early 1990s, aiming for more efficient operations and safer deployment and recovery of air guns and streamers. The 1st to 4th generation Ramforms are about 40 m in breadth and tow up to 22 streamers at most, while the 5th generation Titan-class Ramform has a wider breadth of 70 m and deploys and recovers up to 24 streamers more efficiently and safely.

### 2.2 Survey equipment and relevant machinery

- Streamer winches (left of **Figure 3**)

Deck 3 (open two levels to Deck 5) is equipped with 24 streamer winches to wind up to 12,000 m streamers and other winches, etc., to deploy and recover the streamers efficiently and safely.

- Gun arrays (upper right of **Figure 3**)

Deck 1 (open two levels to Deck 3) is equipped with a system to deploy and store six gun arrays that have air guns linked with buoys, and a winch to wind cables of compressed air and control signals from the ship. Three air compressors are installed under Deck 1 to supply the compressed air during operations.

- Work boats

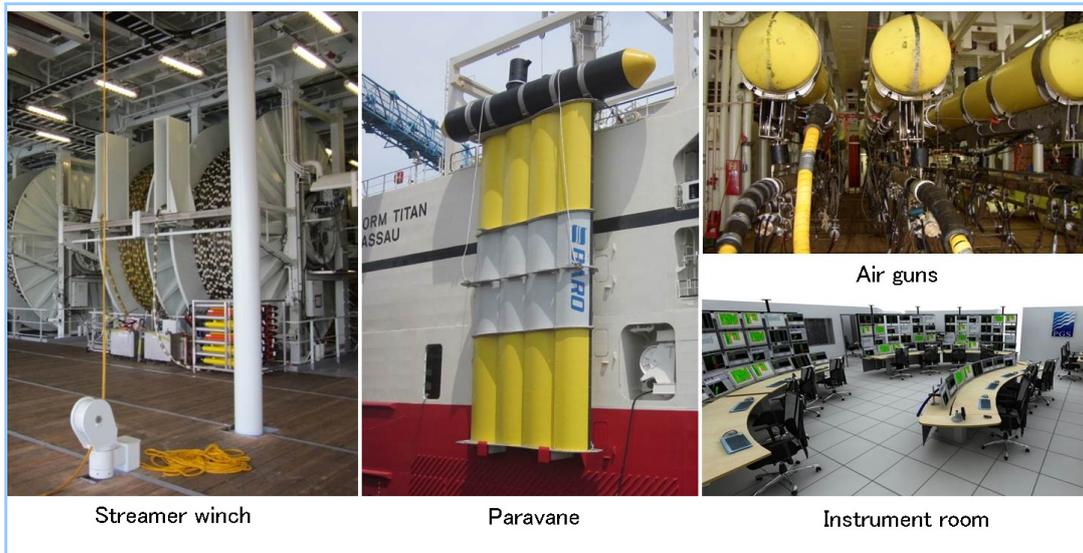
Work boats are used to repair and replace damaged or defective equipment such as streamers on the spot during operations. This approach is more efficient than bringing damaged equipment back to the main ship each time. Deck 1 is equipped with two work boats and systems to launch and recover the boats safely while the main ship is underway.

- Paravanes (middle of **Figure 3**)

A pair of paravanes forms a plate-like towing system to deploy multiple streamers at regular intervals. A shock absorber is placed between the paravane and the winch to mitigate large loads on the ropes during towing.

- Instrument room (lower right of Figure 3)

The instrument room has a computer system to monitor and acquire the observation data and GPS data of the deployed streamers around the clock.



**Figure 3** Survey equipment

### 2.3 Special Purpose Ship Code (SPS Code)

The Special Purpose Ship Code (SPS Code), adopted by the International Maritime Organization (IMO), is a set of rules for the safe operation and equipment of special purpose ships including seismic vessels, which carry special personnel who are not passengers or crew members. The 5th generation Ramform applies the 2008 edition of SPS Code, which applies the passenger vessel rules *mutatis mutandis* and has severer requirements than cargo vessels.

### 2.4 Accommodations

Offshore seismic surveys are conducted around the clock, and if a survey field is extensive it takes several months. For crew comfort, the Ramform series are fully equipped with recreational facilities including a lounge, a TV room, a sauna and an outdoor pool, as well as living facilities including a living room and a dining room. The Titan Class, in particular, is equipped with an indoor ball game court, the most outstanding facility where crews can play full-scale basketball games.

The Titan Class is also equipped with a helicopter deck to shift crews or replenish supplies without mooring and interrupting observations. Bunkering by a bunker ship is also possible while the seismic vessel tows streamers.

## 3. Future vision

Mitsubishi Heavy Industries Ltd. has an ample track record in building ships for various special purposes (e.g., offshore resource surveys, marine research, training and submarine cable installation), as well as conventional merchant ships. Our ship design and building knowledge, as well as our comprehensive skills, are supporting this version of the Ramform. We have concluded an agreement with PGS to build another 2 vessels with revised specifications. The demand for seismic vessels is likely to increase. Based on this version of the Ramform, we hope to attain a position in the domestic and international markets for survey vessel building.