The Latest Technology of "CHIKYU", Deep Sea Drill Ship

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1. Introduction

"CHIKYU", a deep sea drill ship, was delivered to the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in July 2005. Construction of "CHIKYU", featuring the latest technology in this field, opens up a new era of deep sea drilling, with a scientific drill ship adopting the riser drilling method for the very first time in the world. This scientific drill ship was built for the purposes of clarifying long-time environmental changes in the earth, exploring life in the earth's crust, studying the mechanism of earthquakes and so forth, through investigation deep into the earth's core. This paper introduces the Hoisting Equipment, Dual Elevator System, Core Sampling System and Waste Mud Treatment System that form a part of the new technologies developed and adopted in the building of "CHIKYU".

2. Hoisting Equipment

The hoisting equipment for lifting and lowering the drill pipe, the riser pipe and the Blow-out Preventer (BOP) is installed in the derrick. The ship has been engineered to operate in severe environmental conditions, anywhere in the world. It is also intended to be capable of riser drilling in deeper water and of achieving a drilling depth, deeper than ever before. Through analysis of the balance between the hull motion and the weight/vertical vibration/strength of the suspended sub-sea equipment under these conditions, the rated load of the derrick and hoisting equipment (Traveling Block, Crown Mounted Heave Compensator (CMC), Riser Handling Equipment, Wire Rope, etc.) of this ship was designed to be 1 250 tons, the world's largest, in contrast to that of most other similar oil drill ships, which is approximately 907 tons. Accordingly, the derrick and hoisting equipment of this ship were specially developed as up-rated versions, the strength of which has been confirmed. Good operability and safety features have also been achieved taking into consideration equipment-to-equipment interface, equipment layout, equipment automation and so forth.

Table 1 Hoisting equipment rated load

Hoisting Equipment	Rated Load (t)	Remarks
Travelling Block	1 250 t	World's largest
1 250 MT Link	1 250 t	World's largest
Riser Handling Elevator	1 250 t	World's largest
Riser Running Tool	1 250 t	World's largest
Crown Block (CMC)	1 250 t	World's largest
Power Swivel (main load path)	907.2 t	Presently in service
System Link	907.2 t	Presently in service
Dual Elevator	680.4 t	World's first integrated control
Hydraulic Elevator	453.6 t	Presently in service

3. Automation of the Dual Elevator System

During drilling operation, if the pipe is suspended on the drill floor using a wedge known as 'slips', high stress is generated which makes the deep drilling impossible. For this reason, existing scientific drill ships adopt the method of suspending the pipe by using two elevators alternately. However, all work (including attaching and detaching) is performed manually using two elevators. In the case of "CHIKYU", however, a true dual elevator system for the integrated control and operation of the two elevators has been developed and adopted. This system automatically detects the work being done by the two elevators and also their operating condition and with the provision of various interlocks on all equipment, including peripheral equipment, this enables drilling work to be performed safely and efficiently.

Fig. 1 Dual elevator

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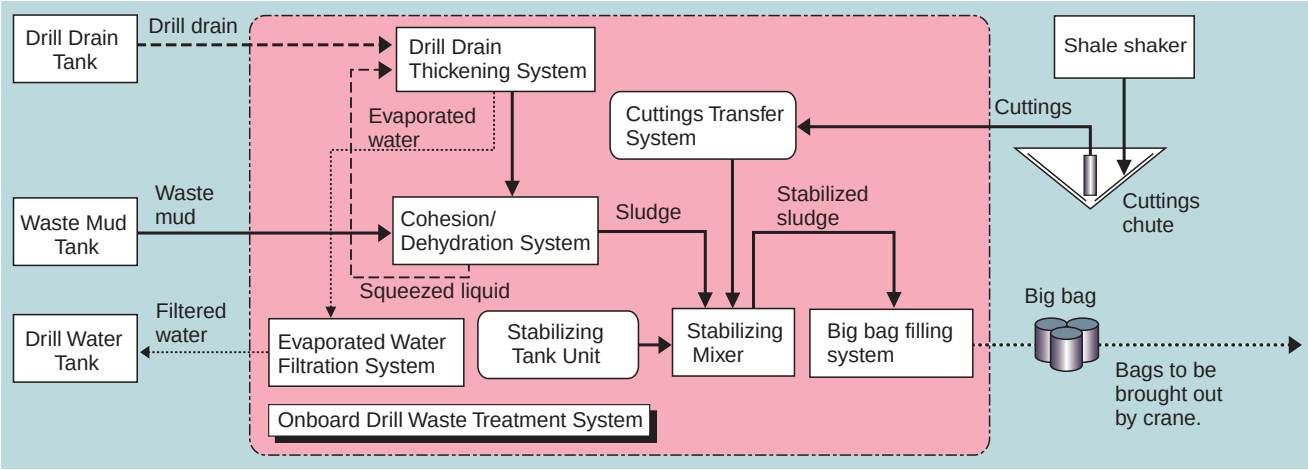

Fig. 3 Waste Mud Treatment System flow

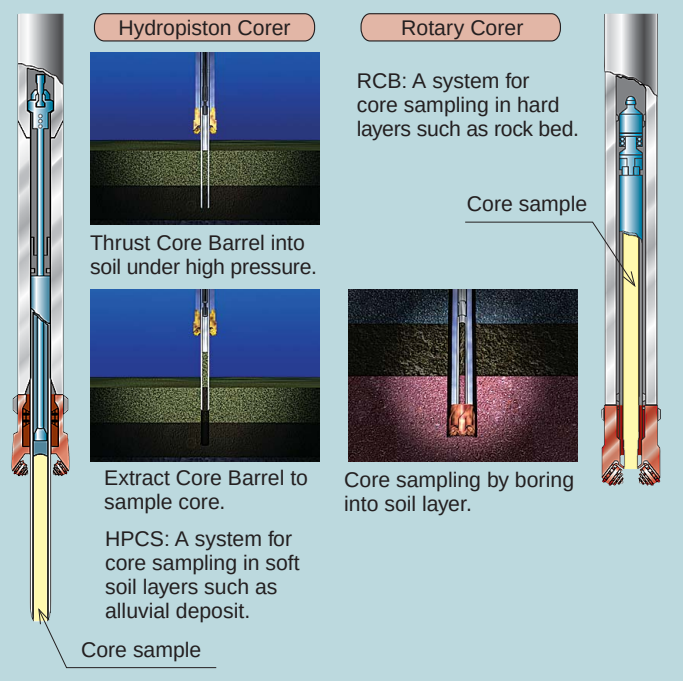

Fig. 2 HPCS and RCB

4. Core Sampling System

The most important purpose of "CHIKYU" is to obtain the targeted core from deep drilling depth. Since continuous core sampling is required, the Wireline method has been adopted for the first time in the world by a riser drill ship. With this method, another container called a core barrel is placed inside the drill pipe, a bit with a hollow center drills the well and the container lifts the core onto the ship. The feature of this method is to retrieve the core without lifting or lowering the drill pipe, which enables efficient coring. The hydraulic piston coring system (HPCS) to obtain soft sediment, the extended shoe coring system (ESCS) to obtain slightly harder sediment, the rotary core barrel (RCB) to obtain hard rock, etc. have each been developed for use, depending on the well.

5. Drill Waste Treatment System

To accord with its status as a "Scientific Drill Ship", "CHIKYU" adopts the concept of zero waste discharge to enable worldwide drilling operation. Discharge water containing mud is distilled and filtered for re-use as drill water. Deteriorated mud is cohered and then dehydrated by pressurization, mixed with cement, bagged and transferred by supply boat to an onshore treatment facility. Cuttings are transferred by vacuum equipment, mixed with cement, bagged and transported ashore. Treatment of cuttings is important for maintaining the expected drilling speed. Therefore, this treatment system was tested on-board using cuttings generated by actual drilling and a maximum treatment capacity of 20 tons/hour was confirmed.

6. Conclusion

"CHIKYU" is expected to start regular operations in 2007 as the principal drill ship in the Integrated Ocean Drilling Program (IODP). In the future, this ship intends to drill into the sea bed to a depth of 4 000 meters. To realize this, it will be necessary to develop deep sea drilling technology incorporating new knowledge obtained from operational experience, as well as new technology from the Oil Drilling Industry. The construction of "CHIKYU" is just the first step and further development will be necessary, in order to reach as yet unexplored fields of sub-sea research.


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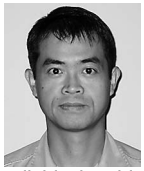
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