DSS
Drilling Sensor Sub

OCEAN DRILLING PROGRAM
www.oceandrilling.org

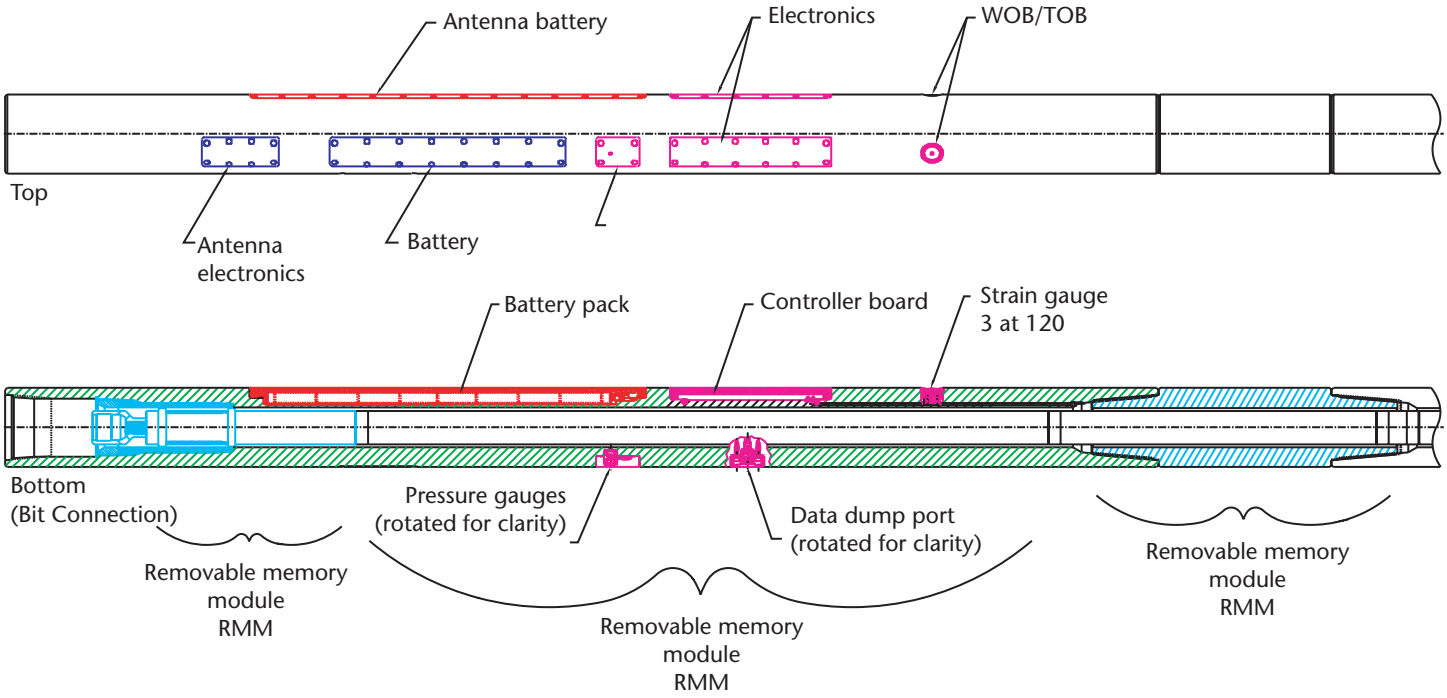
Scientific Application

The Drilling Sensor Sub (DSS) was developed to measure drilling and coring parameters near the bit during operations. The objective of the DSS is to improve downhole tool performance by optimizing control of drilling parameters on the drillship. The DSS sensors measure weight on bit (WOB), torque on bit, annulus and internal pressure, and annulus and instrument temperature. The data are collected by the downhole electronics and stored in memory until the bit and bottom-hole assembly (BHA) are retrieved. The DSS was first deployed during Leg 208. During Leg 210, the DSS was modified to transmit data in real time via a wireless electromagnetic data link to a Retrievable Memory Module (RMM) on the internal core barrel. The data are saved in the RMM's nonvolatile internal memory and downloaded when each core barrel is recovered on the surface. The data allow drilling/coring parameters to be optimized, thereby improving the chance to recover more and/or better preserved core.

The DSS was under development at the end of the Ocean Drilling Program (ODP), and this overview represents the tool status at that time. The DSS will continue to be developed and improved under the Integrated Ocean Drilling Program (IODP).

Tool Operations

The 8¼ in. outer diameter (OD) DSS is run in the 8¼ in. OD BHA and is positioned on top of the outer core barrel. The DSS has the same 4⅛ in. inner diameter (ID) bore as the drill string to accommodate core retrieval by wireline. The sensors, data acquisition electronics, and lithium batteries are packaged in the DSS sub wall. The sensor data are collected by the downhole electronics and stored in memory until the bit and BHA are retrieved. The data for the entire coring run (up to 100 hr) are downloaded on the ship.



Schematic of the Drilling Sensor Sub.

Design Features

1) Compatibility

The DSS is run in the same BHA as the Advanced Piston Corer (APC) and Extended Core Barrel (XCB). The DSS is also compatible with the Rotary Core Barrel (RCB) BHA.

Benefit: The standard ODP coring tools can be used with the DSS, and no additional time is required for extra trips.

2) Actual Downhole Measurements

The DSS sensors measure downhole WOB, torque on bit, annulus and internal pressure, and annulus and instrument temperature. After the sensor sub is retrieved with the bit and BHA, the internal DSS memory provides data about actual downhole conditions near the bit, which can be used to modify surface-controlled drilling parameters to improve performance and evaluate problems.

Benefit: The downhole WOB measurements can be compared to surface controlled drilling parameters and used to determine the effectiveness of heave compensator settings and WOB control. The torque-on-bit measurement can be used to determine optimum WOB, rpm, and hole cleaning techniques to reduce erratic or high torque that could reduce core recovery.

3) Retrievable Memory Module

The DSS measures drilling and coring parameters near the bit during coring operations. The initial DSS version saved the data in internal memory and was recovered with the BHA after coring was completed. During Leg 210, the DSS was modified to transmit data in real time during drilling/coring via a wireless electromagnetic data link to an RMM on the internal core barrel. The data are saved in the RMM's nonvolatile internal memory and the data are downloaded when the core barrel is recovered on the surface. The RMM is redeployed with the next empty core barrel. Data from the DSS are transmitted in real time to the RMM at 80 bits/s (bps), which allows five 16-bit measurements to be transmitted per second. The DSS antenna is switched off when the RMM is removed for tripping to conserve battery power.

Benefit: The RMM enables the drillers and supervisors to review the downhole effects on the coring assembly by downloading and analyzing the data after each core and modifying operating parameters (WOB, rpm, circulation rates) to optimize recovery.

DSS Specifications

General

Tool OD: 8.25 in. – tolerances per API spec 7, para 6.5

Tool ID: 4.125 in. ± .010 in.

Length: 120 in. ± ½ in.

Temperature: -20°C to 150°C

Maximum Hydrostatic Pressure: 15,000 psi

Maximum Pressure differential across sub: 3,500 psi

Electronics

Battery Life: 100 hr
Sample rate, memory: 1 Hz maximum all sensors
Analog to digital resolution: 16 bit

Sensors

Weight On Bit:
Operating Range: ±50,000 lb
Accuracy: ±250 lb

Torque-On-Bit:
Operating Range: ±40,000 ft·lb
Accuracy: ±200 ft·lb

Pressure Sensors (2) – Annulus and drill pipe:
Range: 0-15,000 psi
Accuracy: ±75 psi (0.50% Full Scale Output [FSO])

Temperature Sensor – Annulus:
Range: -20°C to 150°C
Accuracy: ±0.50°C (0.3% FSO)

Temperature Sensor – Internal electronics:
Range: -20°C to 150°C
Accuracy: ±0.50°C (0.3% FSO)

Typical Operating Range

The DSS can be deployed with the APC/XCB/MDCB/PCS and RCB coring systems.

Temperature: -20°C to 150°C

Pressure: 15,000 lb

Limitations

The DSS must be run in the APC/XCB or RCB BHA.

The DSS internal memory must be retrieved with the BHA to access the data.

The data can be retrieved after each core with the RMM on the internal core barrel.

Maximum Downhole Temperature (electronics) = 150°C

Maximum Weight on Bit on the DSS sub = 75,000 lb

Maximum Hydrostatic Pressure = 15,000 psi

Maximum Pressure Differential across sub = 3,500 psi

Maximum Downhole Battery Life = 100 hr