JR

JOIDES Resolution

OCEAN DRILLING PROGRAM

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Scientific Application

The *JOIDES Resolution* (*JR*) is a uniquely outfitted drill ship that can dynamically position over specific seafloor locations while drilling up to 27,500 ft (8385 m) total depth in water depths (WD) ranging from 75 to >6000 m, depending on the desired penetration below the seafloor. The ship is equipped with laboratories for shipboard processing and analysis of cores and borehole data. The derrick houses a top drive system that permits drilling down or reaming up 19.2 m (63 ft) without making a connection. Active and Passive Heave Compensator (AHC/PHC) systems permit drilling/coring with ship heave of up to 16 ft (4.9 m).

The *JOIDES Resolution* scientific drill ship in dynamic positioning mode on location in the Bismarck Sea, 2000, Leg 193.

Design Features

1) Dynamic Positioning

A computerized dynamic positioning system controls 10 (750 hp) vertically mounted retractable thruster pods, 2 (750 hp) keel mounted fixed thrusters, and 2 (4500 hp) propulsion shafts. The seafloor location is marked with a retrievable acoustic beacon. The vessel can maintain position within 3% of water depth in up to 7.5 m (25 ft) waves, 60 knot (kt) winds, and 3.0 kt currents. The minimum water depth for drilling is 75 m (246 ft).

Benefit: Maintains position over a location marked by an acoustic beacon for rapid relocation at a site, for coring close spaced multiple holes, and for quick reentry of holes.

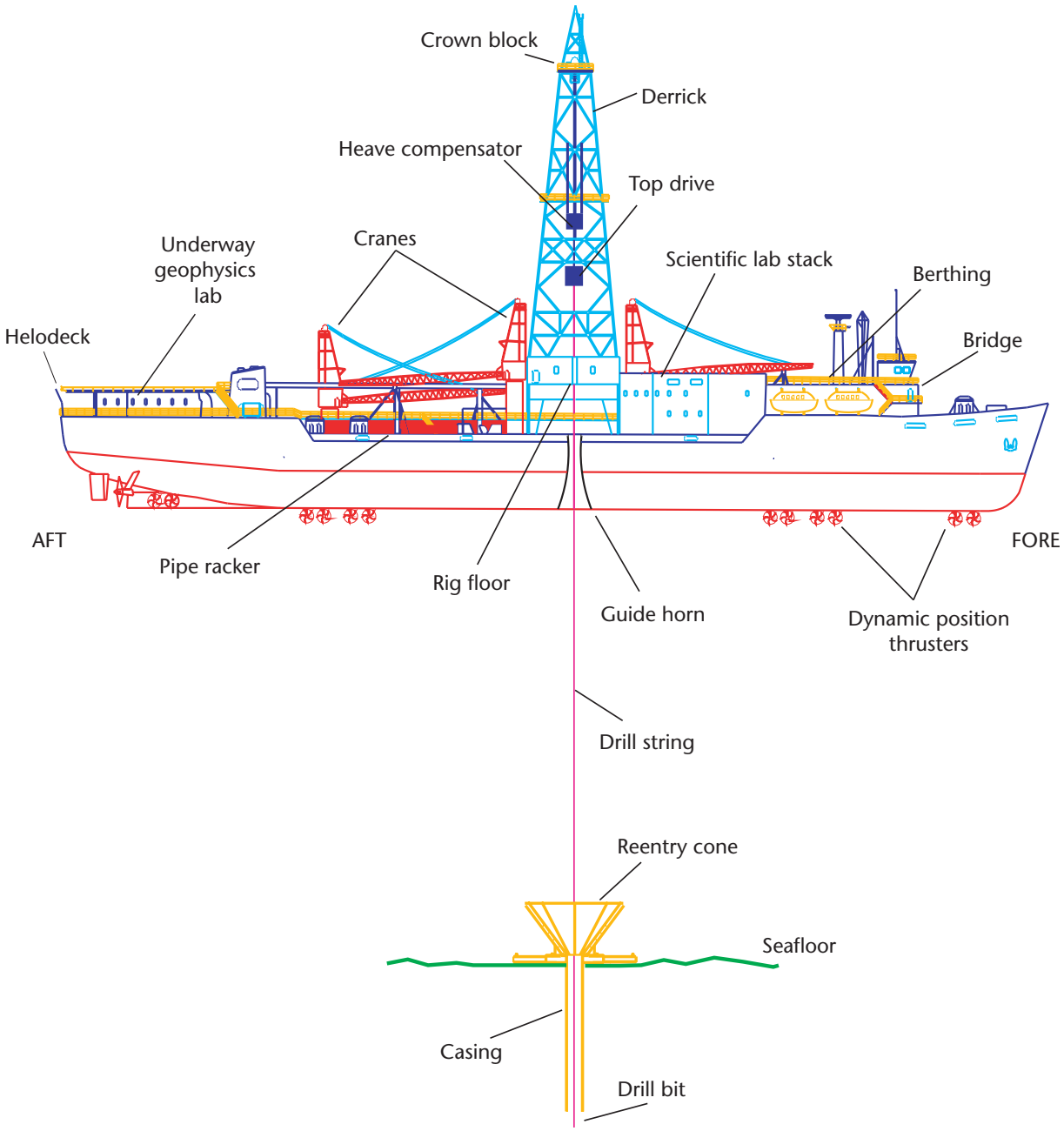
2) Top Drive

A rail mounted top drive system.

Benefit: Permits drilling down or reaming up 19.2 m (63 ft) without making a connection.

3) Passive and Active Heave Compensator

The PHC reduces drill string motion to ~2–4 ft, relative to the ship motion, keeping the drill bit in better contact with the formation despite wave motion. The AHC was added in 1999 to further reduce drill string



Schematic of drilling equipment on the *JOIDES Resolution* drill ship. The drilling mode shown is with a reentry cone; however, most holes are drilled in bare seafloor without a reentry structure.

motion to ~4 in. The PHC is not normally used with the Advanced Piston Corer (APC). The AHC cannot be used with APC coring.

Benefit: Both compensators permit rotary coring with ship heave of 4.9 m (16 ft), reducing weather down time and improving core recovery.

4) Wireline Coring

Split crown and traveling blocks permit a high-speed coring wireline to be run through the drill string. The PHC, hook, top drive, and swivel have 5 in. openings on the centerline to accommodate core barrel operations. The drill floor is equipped with a double-drum high-speed drawworks for core barrel retrieval by coring line.

Benefit: Core barrels and tools can be run and retrieved by wireline at rates of ~200 m/min, which permits rapid continuous coring.

5) Guide Horn

The guide horn consists of two parts (lower and upper sections), which provide a 350 ft internal radius

that imposes a gradual bend in the unconstrained drill string as it exits the bottom of the ship. The upper guide horn section extends from the moonpool doors to the bottom of the rotary opening on the drill floor. The lower guide horn is connected to the upper guide horn by a hub clamp at the main deck level. The two halves of the lower guide horn are attached to the moonpool doors and extend from the doors to the bottom of the moonpool (i.e., bottom of the ship's hull).

Benefit: The 350 ft internal radius limits bending stress on the drill pipe caused by the ship roll, pitch, currents, or ship excursions off location. The two halves of the lower guide horn open with the moonpool doors to allow the crew to run large equipment such as reentry cones, free-fall funnels, and the TV-sonar system.

6) Endurance Onsite

The *JR* can maintain operations with a crew of 112 persons for up to 90 days.

Benefit: Long-term operations in remote areas can be completed without spending time on midleg port calls or added expense for resupply vessels.

Specifications

Official Vessel Number: 6151
Port of Registry: Monrovia, Liberia
ABS Classification: A1 E Drilling Unit AMS ACCU
Ice Class: 1B
Place of Construction: Halifax, Nova Scotia, Canada
Year Built: 1978
Vessel Call Sign: D5BC
Size: Length 470.5 ft by breadth 70.0 ft (143.3 m by 21.3 m)
Tonnage: Gross: 9719 Short Tons (ST), Net: 2915 ST
Displacement: Light Ship: 9479 ST, Maximum Load Line: 18,720 ST

Depth

Reentry Camera and Sonar Operating Depth: <6000 m
Drill String Configuration: High strength knobbies/5½ in. DP/5 in. DP/8½ in. drill collars (DC)
  5 in. DP: 2000–4000 m in pipe racker
  5½ in. DP: 1500–2900 m in pipe racker
Max. Drilling/Coring Depth: 8375 m (at 6° roll and 100,000 lb overpull)
Max. Casing Depth: 8600 m (at 7° roll and 100,000 lb overpull)
Max. Reentry System Depth: 7960 m (at 7° roll and 55,000 lb dynamic load)

The *JOIDES Resolution* in transit for Leg 111 through the Panama Canal.

Typical Operating Drill String:
  Knobbie: 330 m (12 ea) (DC rack)
  8¼ DC: 40 pc (DC Rack)
  Seal bore/nonmagnetic/tapered DC: 10 ea (DC rack)
Typical Riser Hold Storage:
  5 in. DP: 3500 m
  5½ in. DP: 1500 m
  16 in. csg: 60 m (5 jt)
  10¾ in. csg: 350 m (30 jt)
Available Riser Hold Storage (max.):
  20 in. csg: 50 m (4 jt)
  16 in. csg: 350 m (30 jt)
  10 in. csg: 960 m (72 jt) or
  any equivalent combination of csg

Power

Engines/Generators: 7 (16 cyl) Diesel
  5 at 2100 kw (2815 hp)
  2 at 1500 kw (2010 hp)

Propulsion

Thrusters: 9000 hp (10 retractable + 2 fixed at 750 hp each)
Main Screws: 9000 hp (2 shafts), each powered by (6) 750 hp motors

Abbreviations

bbl = barrel
bpm = barrels/minute
csg = casing
cyl = cylinders
DP = drill pipe
gpm = gallons/minute
ea = each
jt = joints
max. = maximum
std = stands

The Varco Top Drive sits below the traveling block and rotates the drill string. The WKM valve (V) is used to close off the drill pipe in the event of a kick, but the wireline has to be removed before the valve is closed. The wiper (W) cleans salt water off the wireline. The wireline ram (R) seals the core line and allows the driller to increase pressure for high-pressure (>400 psi) circulation while the coring line is in the hole or to shoot the APC.

Liquid Capacities

Diesel Fuel: 25,395 bbl (1,066,590 gals.)
Drill Water: 8,438 bbl (354,386 gals.)
Ballast: 5,124 bbl (215,208 gals.)
Potable Water: 176 ST

Mud Pump

Model: (2) Oilwell A1700PT triplex
Power: (2) motors at 750 hp (ea pump)
Liners: 6½ in. at 3,381 psi

Photograph of the traveling block in the derrick with the active and passive heave compensator cylinders (AC and PC, respectively) and swivel. The passive heave cylinders are by Western Gear, and the AHC system was added by Maritime Hydraulics at the 1999 dry dock. The core barrel and coring line are accommodated by a hole through the swivel and traveling equipment as well as a "split" crown.

Mud Pits and Bulk Storage

Pit Volume: 3424 bbl (6 pits + slug)
Bulk Capacity: 13,628 ft^3 (8 pods)

Cementing Unit

Model: Halliburton HT-400
Pumps: 2 charged triplex pumps
Pump Stroke: 4.5 in. x 8 in. = 1.654 gal/stroke at 100%
Max. Pump Rating: 11,200 psi
Unit Output: 210 gpm (5.0 bpm) in low gear
Derrick Hose: 2 in. diameter rated to 5K psi
Bulk Class "G" Cement: fed at 25 to 30 psi
Recirculating Mixer: holds 20 bbl

Derrick

Model: Dreco, 147 ft
Height: 202 ft (62 m) above waterline
Static Rating: 1,200,000 lb
Dynamic Rating:
1,100,000 (at 3° roll)
1,005,000 (at 6° roll)
Vee Door: 70 ft

Moonpool

Diameter: 22 ft on the centerline near mid-ship
Deck-Level Doors: retractable and attached to a split lower guide horn

Crown Block

Model: Dreco-split sheave
Rating: 1,400,000 lb

Traveling Block

Model: Dreco split block with 8 in. opening for coring tools
Rating: 1,200,000 lb

Passive Heave Compensator

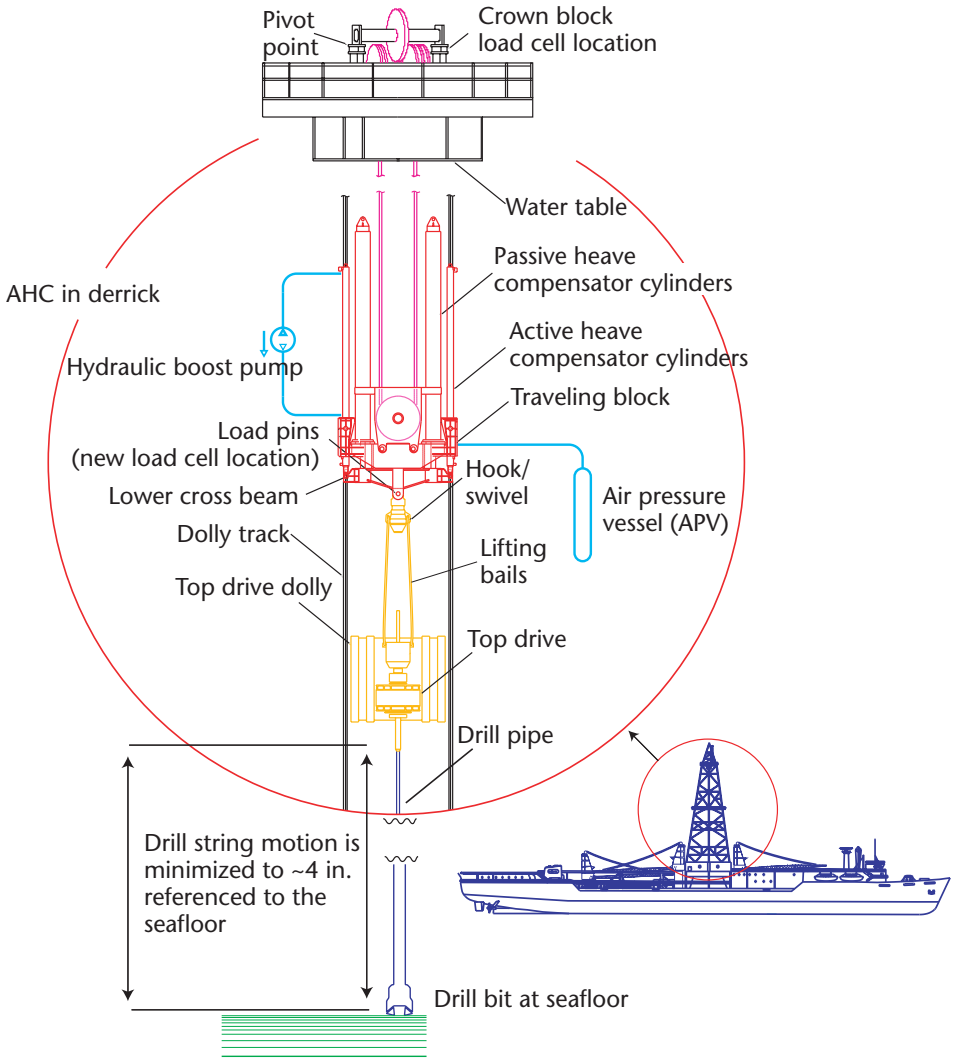
Model: Western Gear 800-17-20
Lift Capacity: 800,000 lb active/ 1,200,00 lb locked
Max. Operating Conditions: vessel heave 16.4 ft (5 m), 6 sec. period
Total Stroke: 20 ft (6.1 m)

Active Heave Compensator

Model: Maritime Hydraulics, 500 hp, 170 hp in reserve
Efficiency: >90%, 20 milsec response
Stroke: 25 ft
Residual Motion: ±3 in.
Operating Limit on AHC:
Ship velocity 4.3 ft/sec
PHC stroke: <16 ft

Rig Instrument System

Model: Data Wise Solutions Inc., Tru Vu PRO
Touch Screen Rig Floor Display: monitors and records 100 data variables
Data Sample Rate: 2 Hz (½ sec)
Max. Data Record Rate: 1 Hz (1 sec)
Variables Monitored: rig floor drilling parameters, ship motion, real-time measurement-while-drilling/logging-while-drilling (MWD/LWD) data



Schematic of the AHC in the derrick on the *JOIDES Resolution* with inset diagram showing equipment details.

Hook

Model: National J-600
Rating: 1,200,000 lb

Swivel

Model: National P650
Rating: 1,300,000 static, 904,000 rotating
Gooseneck equipped with valve, wireline, BOP, and oil saver for coring tools

Top Drive

Model: Varco, TDS3
Rating: 1,000,000 lb
Motor: EMD M89 electric, 1000 hp (Intermittent 1250 hp)
Continuous torque, 31,000 ft-lb
Intermittent torque, 41,300 ft-lb
Max Speed: 250 rpm

The *JOIDES Resolution* entering St. John's harbor, Leg 150, 1991.

Drawworks

Model: Oilwell, E3000
Motors: (2) EMD D-89-MB electric, 1,000 hp each
Line: 1¾ in. wire rope
Brake: (2) Baylor Eddy-Current, Model 7838, 117,000 ft-lb
Max. Torque: 96,000 ft-lb at 50 rpm

Dual Elevator Handler

Model: Varco DEHS/471
Horizontal Reach: 60 in.
Vertical Reach: 36 in.
Elevator Size: 350 or 500 ton, special modified side-door

Iron Roughneck

Model: Varco, IR2100
Wrench Range: 3½ in. to 8½ in. diameter
Makeup Torque: 63,000 ft-lb
Breakout Torque: 75,000 ft-lb
Vertical Travel: 33 in.

Rotary Table

Model: Oilwell, A-49½
Motor: EMD D79-MB electric
Max. Speed Output: 325 rpm

Core Winch

National, independent drive double drum
Motor: D79 electric, 750 hp
Capacity: 31,000 ft (9,448 m) per drum
Line: ½ in., (3) 18 EIP swaged wire rope

Cranes

Crane #1: Bucyrus Erie Model MK60 with 80 ft boom, 6 ton whipline, 25.5 ST at 53°
Crane #2: Bucyrus Erie Model MK60 with 80 ft boom, 6 ton whipline, 42 ST at 67°
Crane #3: Bucyrus Erie Model MK35 with 80 ft boom, 5 ton whipline, 25.5 ST at 53°

Pipe Rackers

Racker #1: Western Gear
Racker #2: Victoria Machine Works
Western Gear Port: 130 stds, 5 in. DP (3750 m) (12,300 ft)
Western Gear starboard inner racker: 130 stds, 5 in. DP (3750 m) (12,300 ft)
Victoria M/W starboard outer racker: 104 stds, 5½ in. DP (3000 m) (9830 ft)

Miscellaneous

Deck Load: 9534 ST
Moonpool Diameter: 22 ft (7 m)

Crew Compliment (max. 112)

Drill and Ship's Crew: 47
Catering: 14
ODP Staff: 25
Scientists: 25

Lifeboats

Model: Watercraft, enclosed
Capacity: 65 each (56 in survival suits)
Number: 4; 2 port and 2 starboard

Liferafts

Number: 5 enclosed
Capacity: 25 each