

DDI – LSFLs Today and Yesterday

DEEP DOWN

9/30/10

10/18/10

DDI SFLs

Past – Present - Future

- Conception
- Development
- KOS generation #1
- KOP generation #2
- Loose tube SFL (LSFL) with KOP Cobra
- DDI Moray generation # 3
 - Compliant
 - LSFL
- SEASTAX Pallets
- Palletizing
- 4th Development

Industry HFLs Problems

- Shell Popeye – Rogan & Chandley – all leaked – 1704 stems
- Shell Mars – Rogan & Chandley – all leaked
- Shell Tahoe – Rogan & Chandley – all leaked
- BP Marlin 1 – Duco HCR – Leaked and partial collapse
- BP Marlin thermoplastic umbilical replaced by steel
- BP Enterprise – Work over umbilical – HCR – three burst hoses – DDI finds and repairs in the field
- Shell Malampaya – OMUK workover umbilical – electrical and hose failures
- Exxon Diana - Leaks
- Amerada Hess – Northwestern – HCR Leaks
- BP king qualifies – Duco HCR for high flowrates – Fails due to internal erosion of the carcass. Multiflex HCR passes. BP switches to LSFLs
- BP Pompano umbilical replaced with steel umbilical
- Santa Fe GB 224 & Oryx failures

DDI SFLs

Development Phases

- Thermoplastic umbilicals used to connect directly to the tree. Once divers bent the umbilical torsion increased making it very difficult – in 1988 the seed was planted during this Oryx Installation

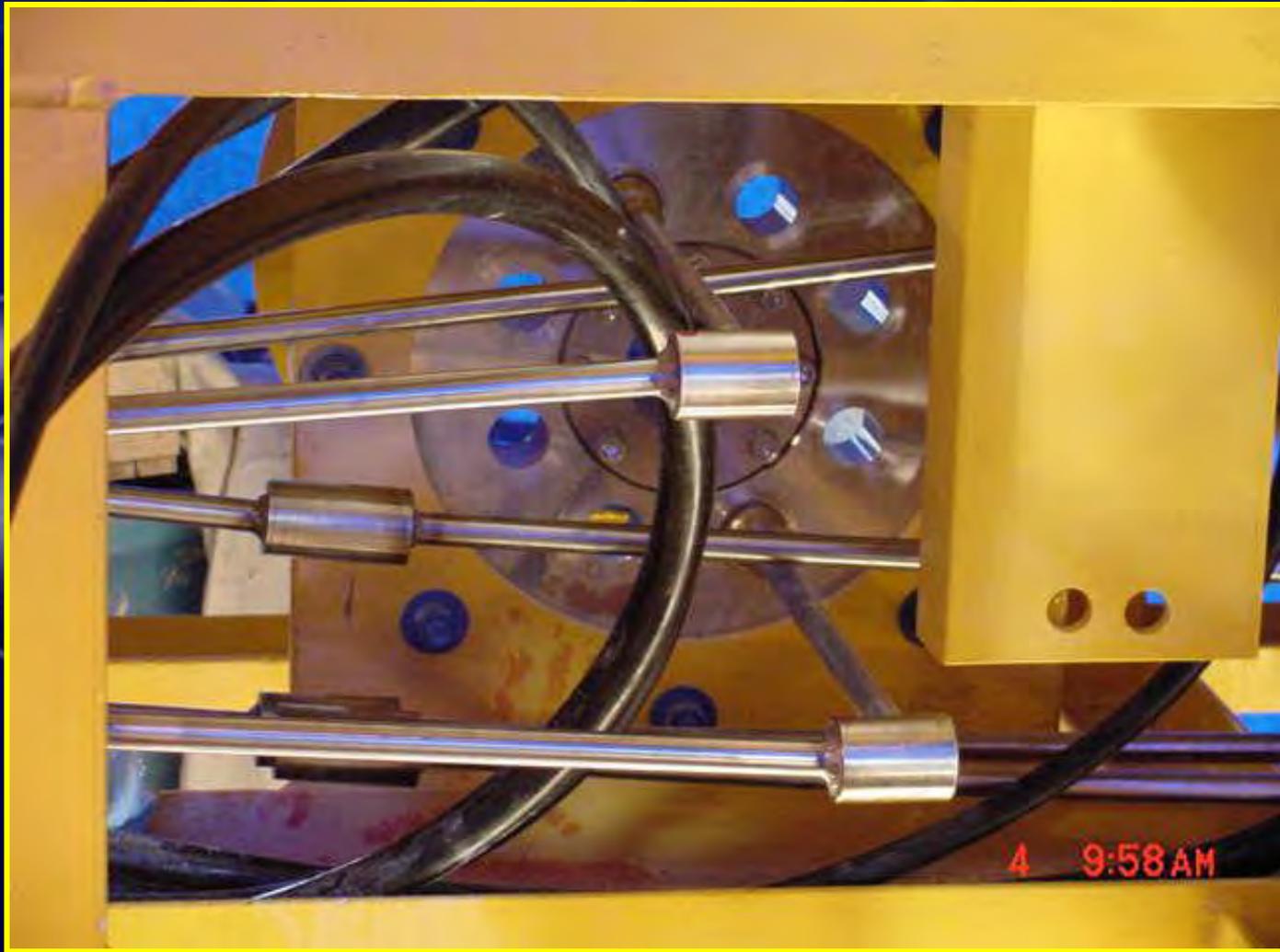


DDI SFLs

1st Development Phases

- Steel tube umbilicals were becoming the norm
- Steel tubing were on the platform
- The tree and UTAs were tubed in Steel
- It is time for a steel tube flying lead
- First step is to eliminate the torsional effects and deal with any torsion that remains.
- The Cobra head & FLOT are conceived
 - CG must be below and the buoyancy above
 - The connection must be made without bending the umbilical
 - The ROV must be able to fit into the J-plate and fly the lead
 - Cobra
 - There must be a rigid way to transmit bending stresses to the ROV – FLOT
 - Need compliance between Cobra and the jacketed umbilical

Welded fittings are simple and don't leak



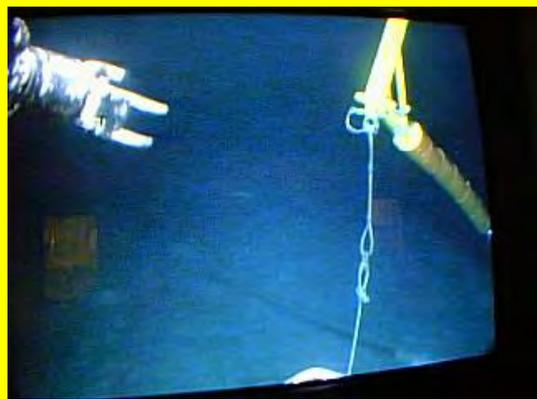
DDI SFL Track Record

No Leaks

- Shell Macaroni – Multiple 450 feet
- Shell Angus – Multiple 450 feet
- Shell Europa – Multiple 450 feet
- Shell King – Vetco S&HO one end and KOS cobra other end
- Amerada Hess – Conger 5,900 feet – 11 tubes 15KSI & 2 – 450’
- Shell Serrano & Oregano – Multiple 450 feet
- BP King – Multiple LSFLs – 150’
- BP Marlin SS# 2 – Multiple LSFLs 150 and 200’
- BP Canyon Express – 39 LSFLs
- Kerr McGee Navaho – 8,000 foot DDI compliant Moray
- Shell Manatee – Multiple 450 feet
- Shell Serrano & Oregano Phase 2 – Multiple 450 feet
- BP Aspen – 14 tube 400 feet LSFL, floating flushing plates
- BHP Boris – 20,000 foot DDI Compliant Moray
- BP King West – Four LSFLs & HFLs
- Boris 2 – LSFL 150 ft.



KOS Cobra Generation 1



DDI SFLs

2nd Development Phase

- Cobra taller then it needs to be - new compact design developed
- Need to transmit tube strength to the cobra
- Bend segments need not to be buoyant so Cobra sits upright on the seafloor for easier connections





KOP/DDI Generation 2





Installation Generation 2



5900ft with electrical strapped on & two 450' SFLs – 11 tube 15,000 psi

DDI SFLs

3rd Development Phase LSFLs

- Need Integrated bend limited to protect the exposed tubes from segment all sliding to one end
- Need to increase compliant length if the umbilicals are going to get any bigger
- Don't need big pot at the end of the umbilical section – Tubes can be welded all along under the compliant section
- Don't even need conventional jacket umbilical for flying leads. Loose tube in Overhose are more flexible
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DDI LSFLs

Present

- **Loose tube steel flying leads (LSFL)**
 - With KOP Cobra generation 2
 - With KOS Cobra generation 1
 - With DDI Moray generation 3
 - With DDI Moray generation 4
- **DDI compliant Moray single umbilical connection**
- **Horizontal Moray fits anyones j-plates**
- **Vertical Moray fits anyones j-plates**
- **SEASTAX Pallets**
- **Palletizing**



SEASTAX pallet Cube pinned and lifted as single magazine – Perfect for multiple SFL installations



King used Standard baskets and was transported without permit making this an ideal method for up to 6 flying leads



DDI SFL Laying spread onboard
O12 – BP King & BP Marlin SS #2



4th Development Phase Compliant Morays

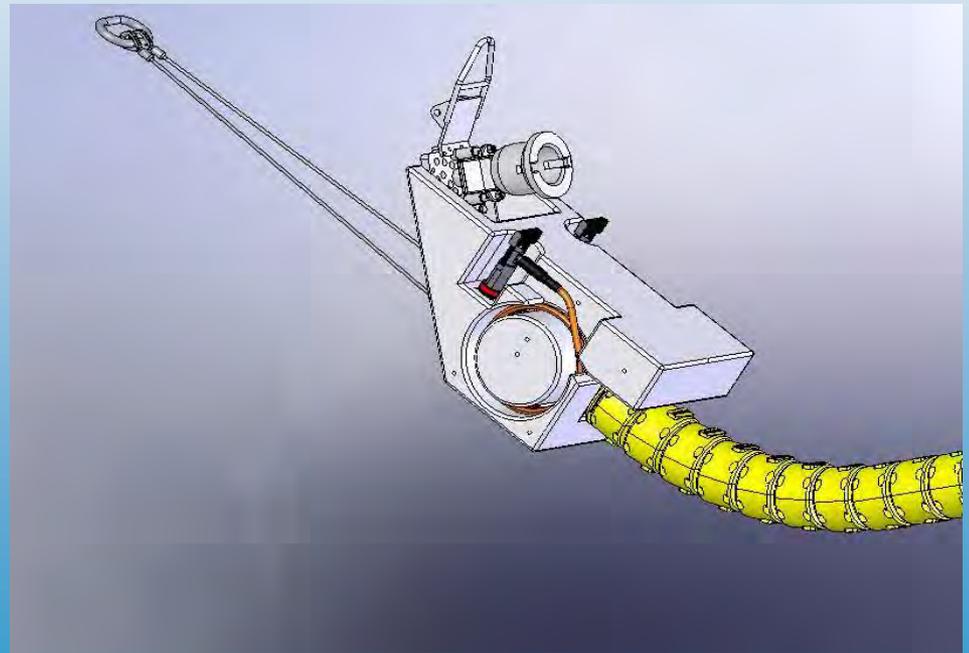
- Don't need UTAs if the umbilical can be plugged directly to the tree like the old days
- Need to lengthen the compliant area to 20 feet to compensate for any umbilical stiffness
- Need to incorporate handling of the electrical cable and transition to EFL
- Need to carrying installation tension of catenary
- compliant Moray is born and evolved from the 5,900 foot long SFL to the tree under the drilling rig



Deep Down Inc
Next Generation Moray

The Moray™ Termination

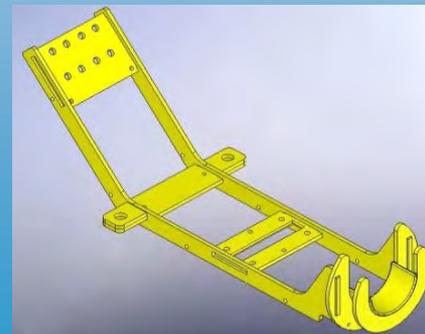
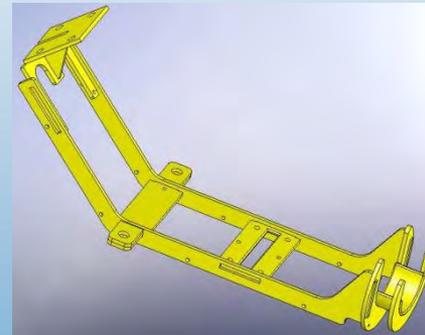
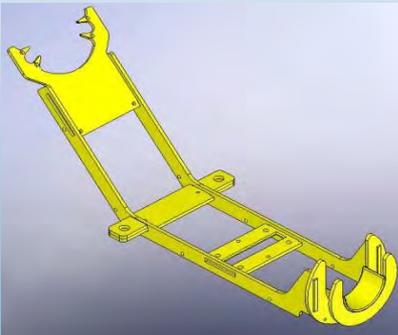
A highly configurable and installation friendly flying lead; supporting hydraulic and combined hydraulic, electric and optical installations.



The Moray™ Termination

Universal Frame Assembly

- Interchangeable interface plate, supports all plate mfg
- Light weight, 45 pounds unloaded
- Rated for 10 ton axial load
- Complete elimination of epoxy armor pot



Horizontal EH Moray on Navaho to OMUK Steel tube umbilical



The Moray™ Termination

Revolutionary DOP™ (Deep Over-Hose Protection) System

- High strength redundant over-hose
- Rated for 10 ton axial load
- Significantly increases maneuverability of heads
- Smaller MBR, shipped on 8' reel





Vertical EH Moray can be easily adapted to everybody's plates. Can also have wet mateable connector and EFL

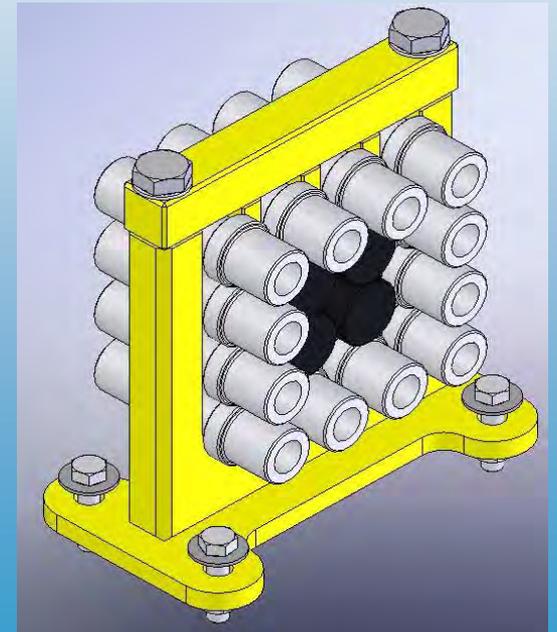
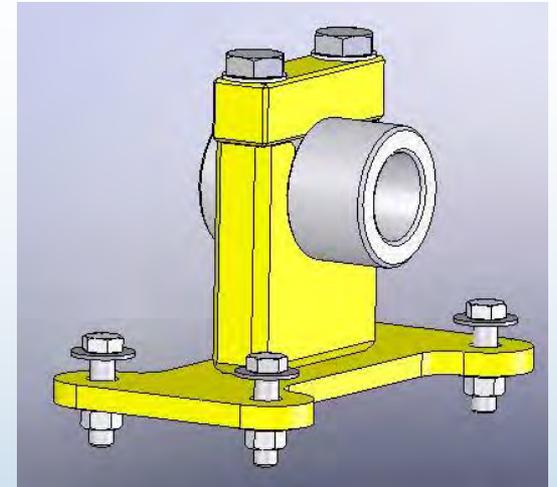
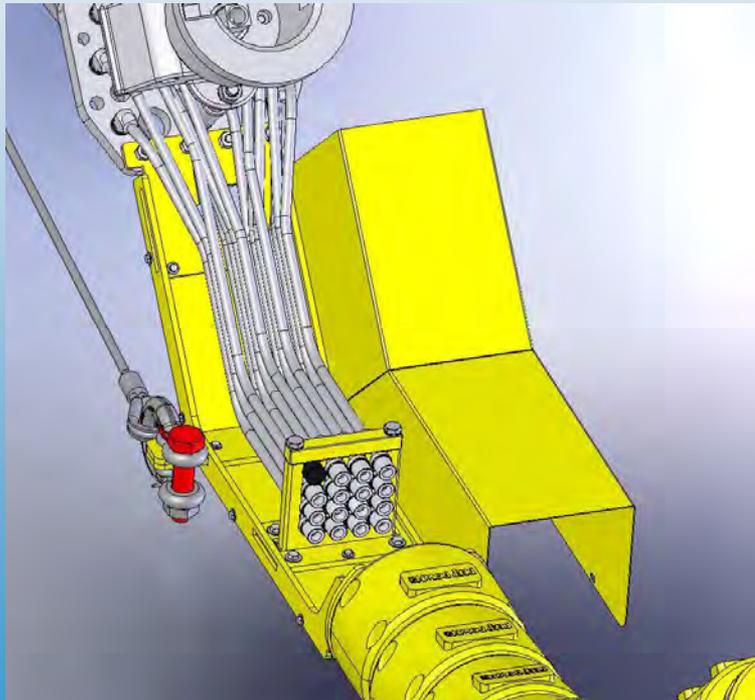
BHP Boris – DDI Compliant Morays (Quantity 3)



The Moray™ Termination

Configurable Strength Termination

- Steel tubes
- Hoses
- Mix & match



DDI supplied Moray terminations to BP Aspen & BHP Boris

- BP Aspen ordered 5 Moray SFLs
 - 4 - 400 ft
 - 1 – 150 ft
- **BHP Boris Ordered three compliant Morays**

DDI Horizontal Moray



ABB J-Plate

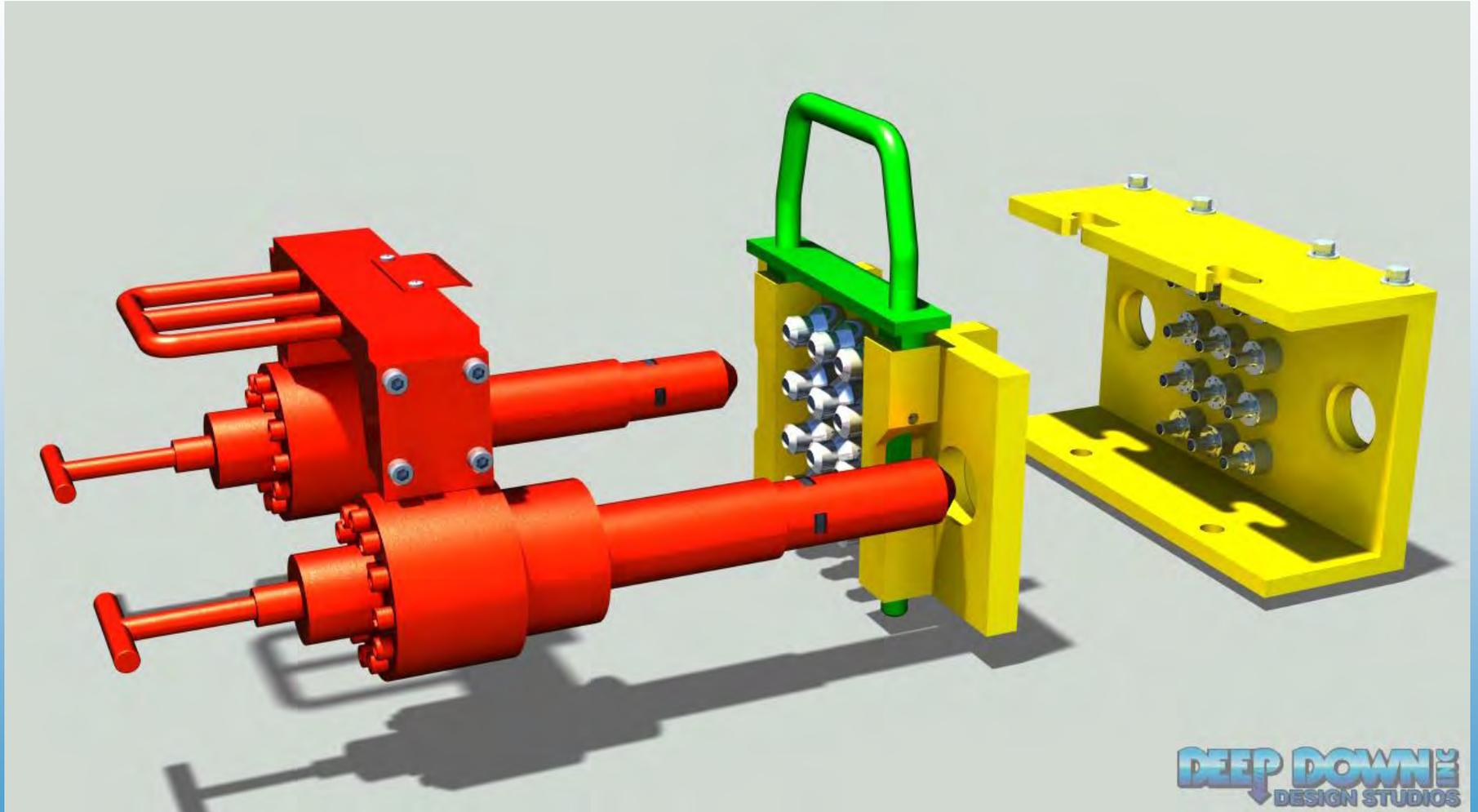
Loose flying leads are very manageable on the sea floor and have NO MEMORY!!



This is not memory, it is flexibility as it sits almost neutrally buoyant on the seafloor waiting to connect to the SUT



The New Patented J-Plate



DEEP DOWN
DESIGN STUDIOS

DEEP DOWN
DESIGN STUDIOS

JURUNATURE SDN BHD

The Moray™ Termination

Proven History (Over Ten Years In The Field Without A Single Failure)

- Amerada Hess: Conger
- Anadarko: Genghis Khan, K2, Independence Hub, Jubilee
- ATP: Gomez
- Baccarat:
- BHP: Little Burn, Boris, Boris 2
- BP: King, Marlin 2, Aspen, King West, RMS, ADCP, Thunderhorse
- Elf Exploration: Canyon Express
- Exxon Mobil: Erha, Erha North, Bahamian Power Distribution
- Helix: Phoenix, Typhoon, Noonan,
- Kerr McGee: Navajo
- MEGI: Zafiro
- ONGC:
- Shell: Macaroni, Angus, Europa, King, Serrano, Oregano, Manatee
- Total: Akpo

