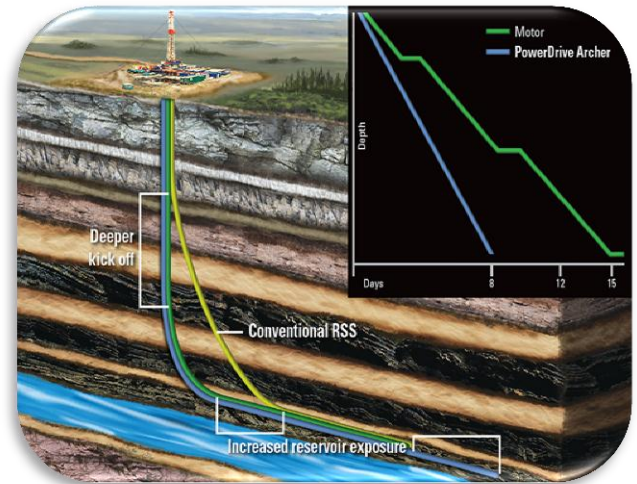


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September 2013

Drilling Systems

IGU Joint Committee Meeting

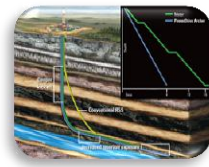
Working Committee 1 - Study Group 1.1

Bramanta Subroto

Team Leader Drilling Engineering

New Technology in Oil & Gas, Why we need?

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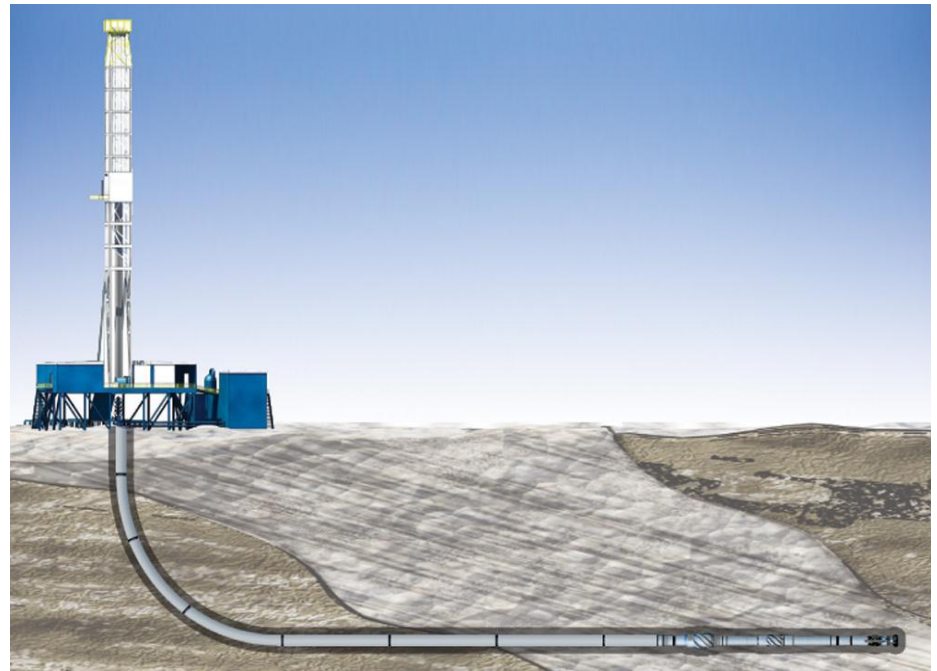
- As reserves are depleting/declining, operators are forced to explore for Oil and gas in increasingly complex locations and formations. How can these reservoirs be explored and developed successfully and cost effectively? What do operators see as the greatest challenges in these complex environment?

- **Well Placement Risk**

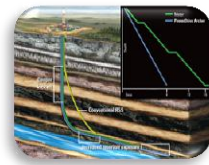
- Surveying
- Data transmission
- Long step out - ERD
- Shallow reservoir – High Dogleg

- **Formation Risk**

- Mud losses – telemetry
- Unconsolidated/Hole stability
- Hard Formation
- HTHP



Well Placement Risk - Surveying



Advanced Lateral Services

- GRS - Geomagnetic Referencing Service (IFR)
- DMAG

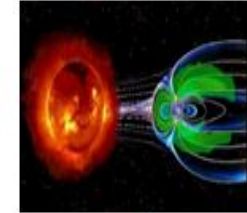
Advanced TVD Services

- BHA SAG – correction
- HDS – correction
- Smart Depth - correction

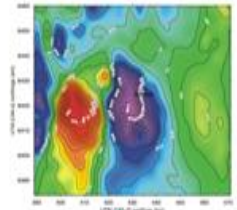
Drillstring interference



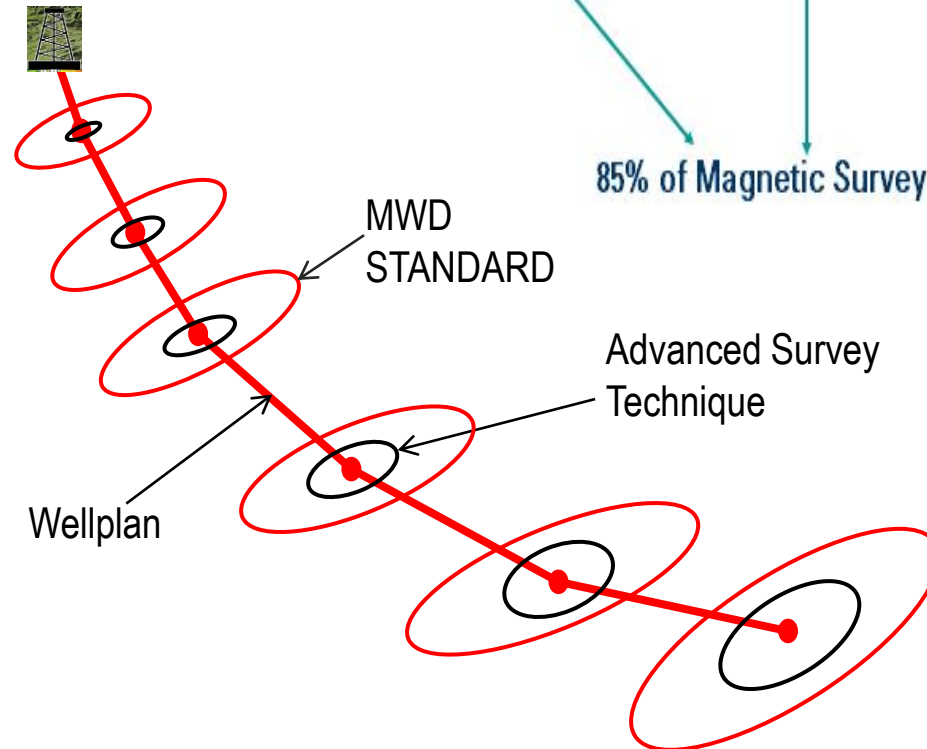
Magnetic Variance



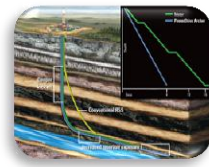
Crustal Field



85% of Magnetic Survey Errors



Well Placement Risk- Long Step Out (ERD)



PowerDrive X5

Everything Rotates
Proven workhorse
Over 70 Million Feet

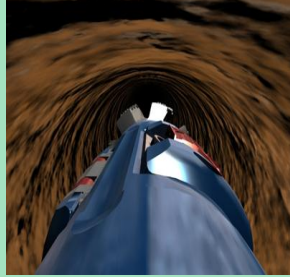
15 1/2 – 28in
Bit Sizes

12in – 14 3/4in
Bit Sizes

10 5/8 - 11
5/8in
Bit Size

8 1/2in – 9
7/8in
Bit Sizes

5 1/2in – 6 3/4in
Bit Sizes



PowerDrive X6

Same Principle
Increased reliability
Enhanced capability

15 1/2 – 28in
Bit Sizes

12in – 14 3/4in
Bit Sizes

10 5/8 - 11
5/8in
Bit Size

8 1/2in – 9
7/8in
Bit Sizes

5 1/2in – 6 3/4in
Bit Sizes



Power V

Vertical only system
Completely automatic
Minimal personnel

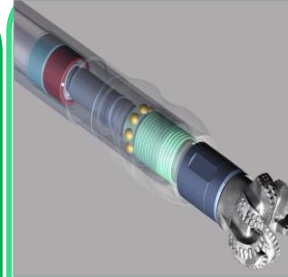
15 1/2 – 28in
Bit Sizes

12in – 14 3/4in
Bit Sizes

10 5/8 - 11
5/8in
Bit Size

8 1/2in – 9
7/8in
Bit Sizes

5 1/2in – 6 3/4in
Bit Sizes

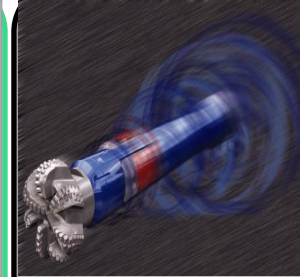


Xceed

Unique design
Minimal contact
Unique capability

12 1/4" – 17
1/2" in
Bit Sizes

8 1/2" - 9 7/8 in
Bit Sizes



vortex

DH Powered RSS
X5, X6 or Xceed
Increased efficiency

15 1/2 – 28in
Bit Sizes

12in – 14 3/4in
Bit Sizes

10 5/8 - 11
5/8in
Bit Size

8 1/2in – 9
7/8in
Bit Sizes

5 1/2in – 6 3/4in
Bit Sizes

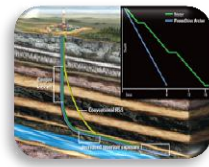


Archer

High DLS RSS
Increased efficiency

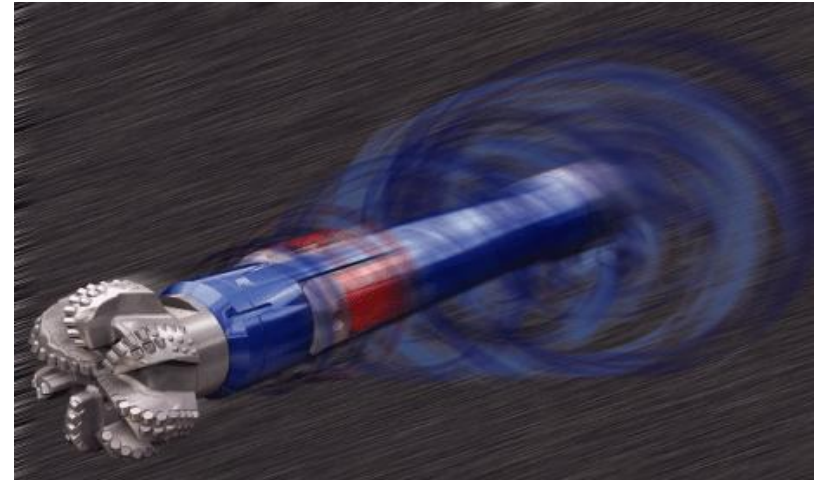
8 1/2" – 8 3/4"
Bit Sizes

5 3/4" - 6 1/2 in
Bit Sizes

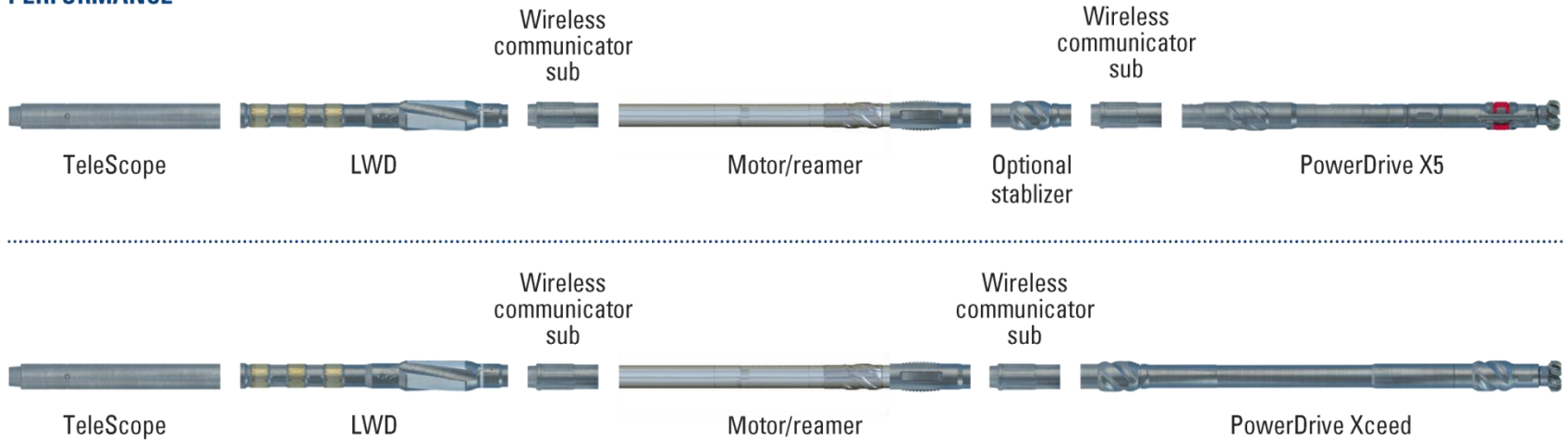


RSS Vortex Application

- Performance
- Rig Limitation
- Reduce Casing Wear

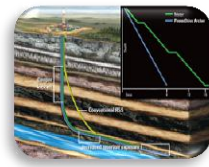


PERFORMANCE



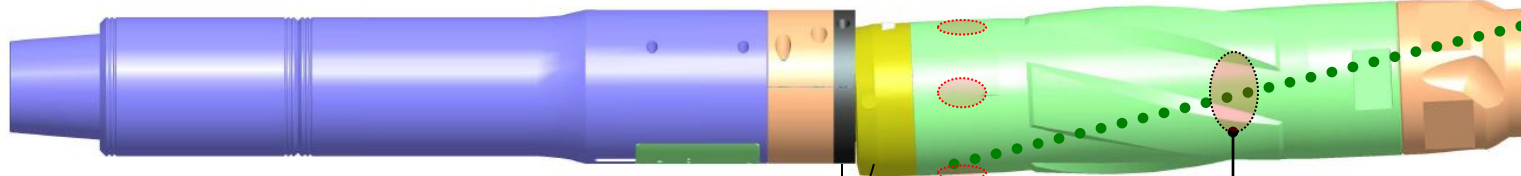
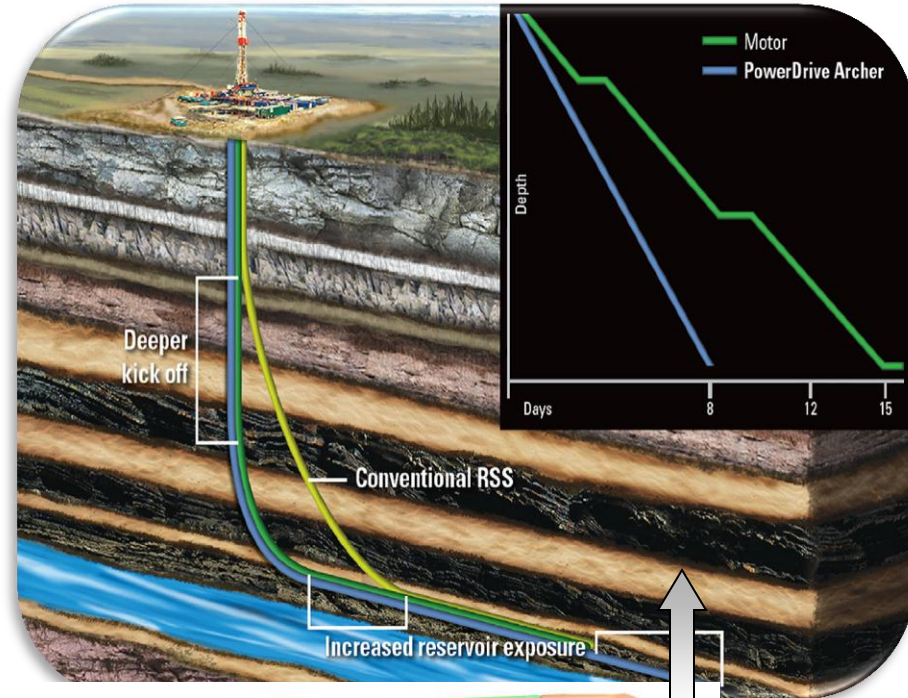
Well Placement Risk- High Dogleg

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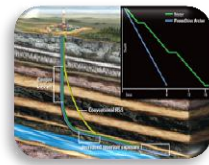
Power Drive Archer

- High DLS capability
 - Stay vertical longer, kick off deeper
 - Faster drilling, reduced cost
 - Reduced risk
 - Enter reservoir earlier
- DLS assurance
 - Control in unconsolidated formations
 - Punch through hard layers



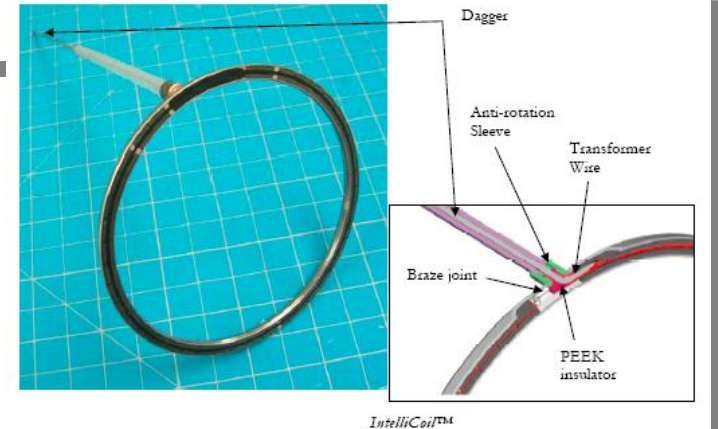
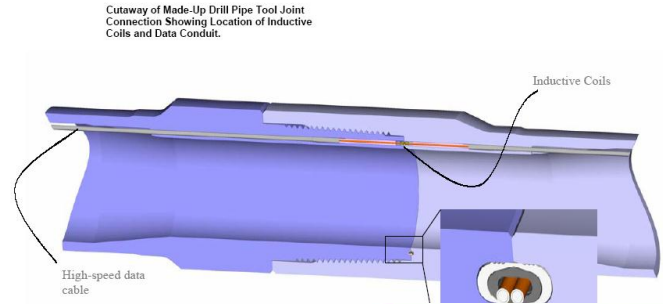
Strike ring limit the offset
(0.6°, 0.8°, 0.9°, 1°)

Universal joint acts as
pivot point



Wired Drill-pipe Features

- Higher bandwidth
- Bi-directional communication
- Along string measurements
- Pumps off measurements
- Low latency
- Time synchronization



GRPI8

adhVISION825

sonicVISION 825

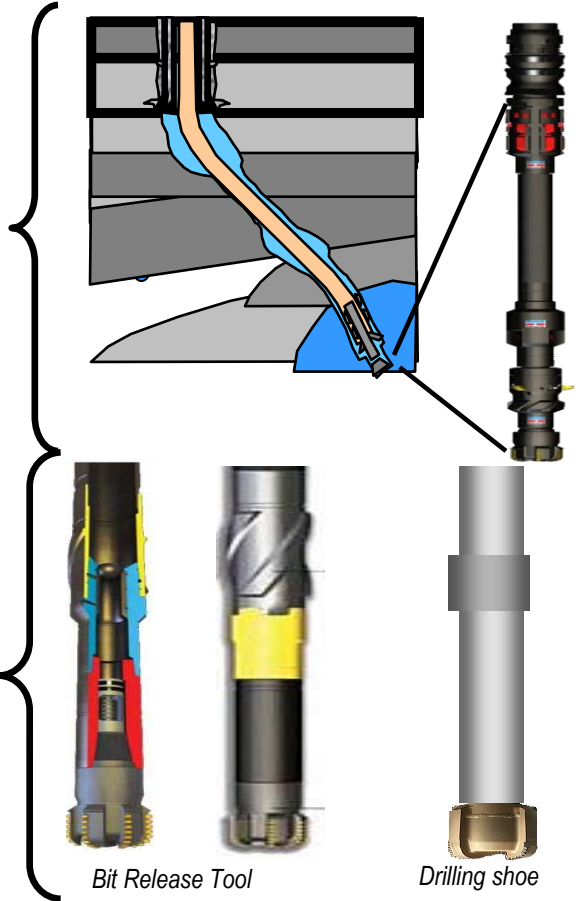
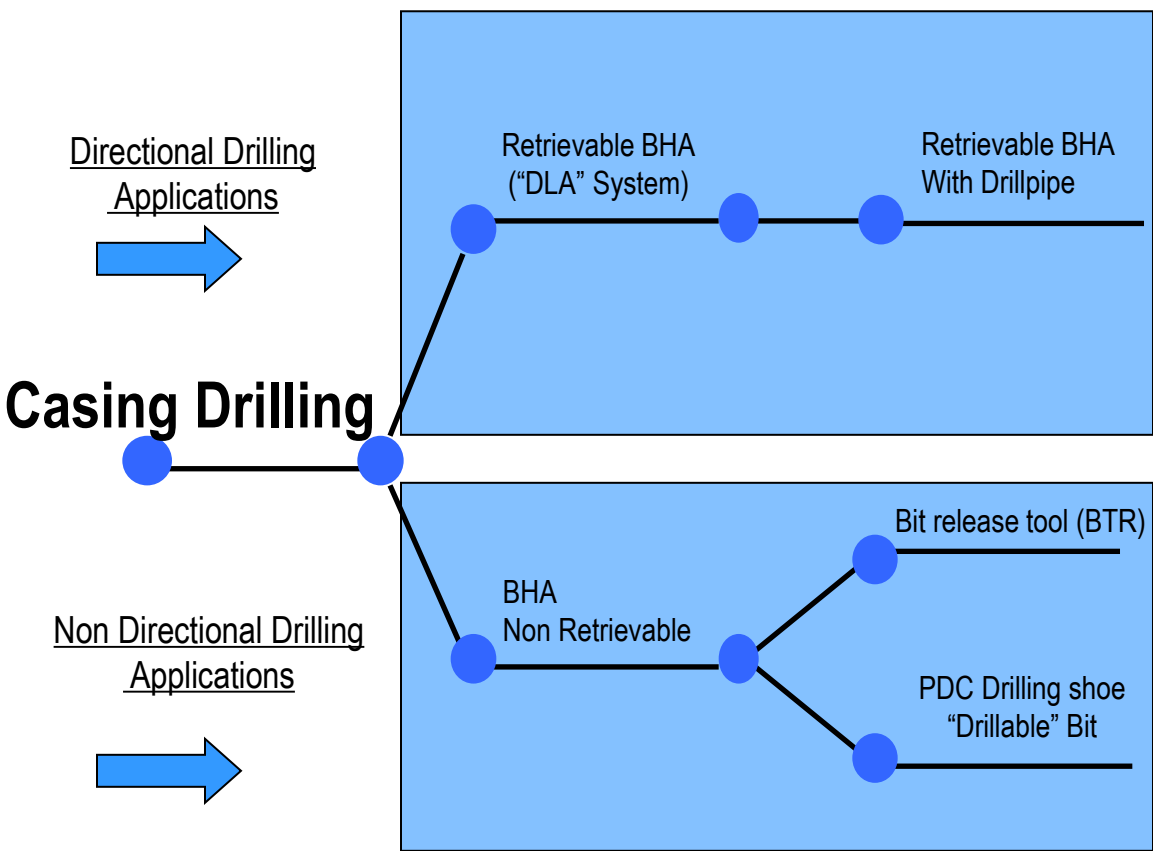
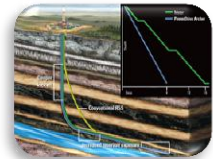
TeleScope 825

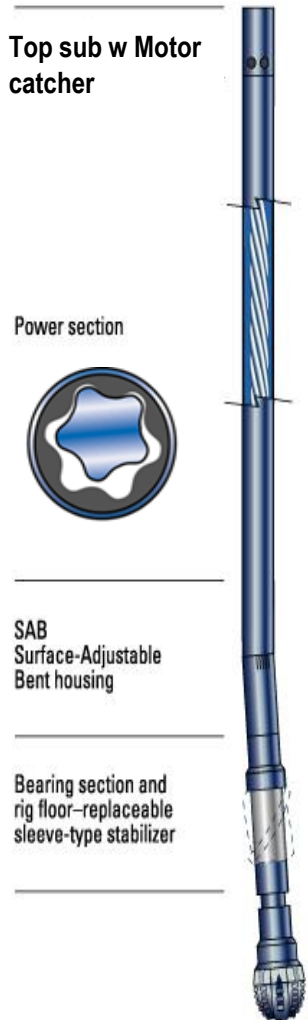
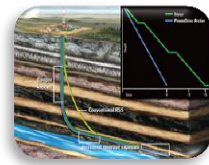
arcVISION825

PowerDrive Xceed 900/PowerDrive X5 825



Formation Risk – Unconsolidated/Hole Stability

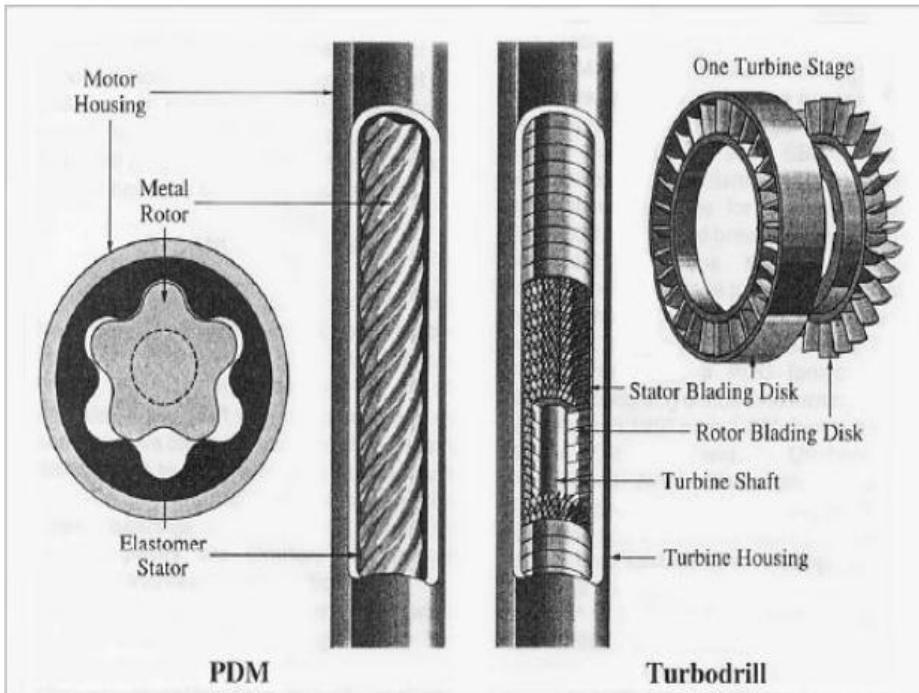
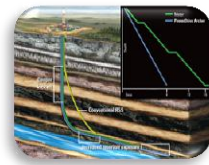




- **Power Pak ERT is A high performance PDM delivering up to twice the torque output**
- **Suitable for any high performance motor application**
 - vorteX operations
 - Performance drilling
- **Max 6 Motor is future of ERT development**
 - Archer vorteX operations
- **Power Pak HR (Hard Rubber)**
 - The new elastomer is a NBR (Nitrile Butadiene Rubber) mechanically stronger and has better fatigue resistance
 - Provides better chemical resistance, in certain applications.



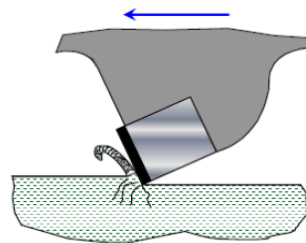
Formation Risk – Hard Formation



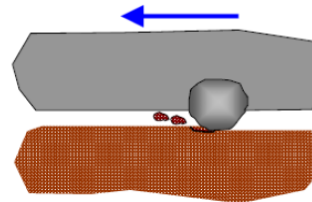
— **Turbodrill** uses high RPM to drill rather than Torque. (ex. 12-1/4" HS; 800RPM)

— **Application**

- HTHP
- Sidetrack
- Hard Abrasive Formation
- Underbalance
- Geothermal
- Exotic Fluid

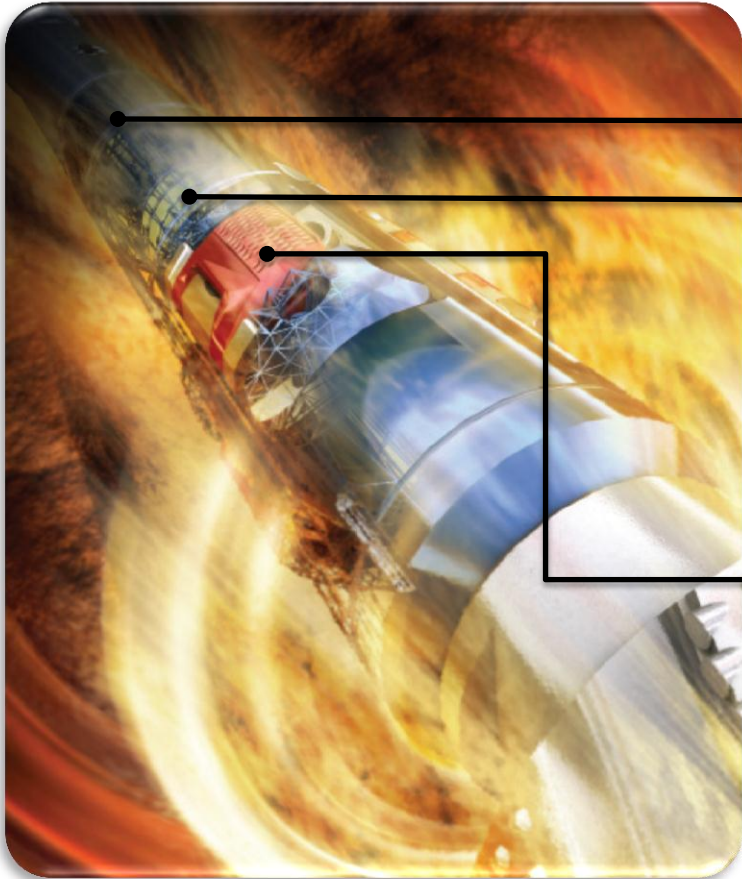
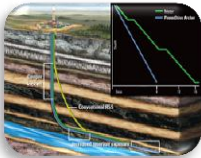


PDC Bits drill by shearing the rock
Rocks typically fracture more easily with shear loading (more torque, WOB)
Most efficient cutting action



Natural Diamond Bits drill by plowing and grinding the rock
Normally require higher RPM for better performance (e.g.: high speed motor or turbine)

Formation Risk - HTHP

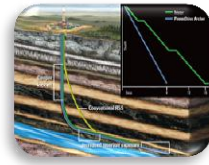


Sensors
- D&I, GR, APWD



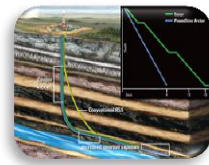
Radical Change in HT Technology

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- 200 degC [400 degF] MWD
 - Full proprietary ceramic electronics
 - High-speed telemetry
 - Ultra HT sensors:
 - D&I
 - GR
 - APWD
- 200 degC [400 degF] RSS
 - Proprietary ceramic electronics technology
 - Revolutionary HT bias unit





Understanding the Risks

- Well Placement Risks
- Formation Risks

Early engagement and collaboration analysis between operator and service companies will help to identify solutions.

Fit for purpose technology and solution to the well challenges will increase drilling efficiency and success of the well.