Advances in HP/HT Subsea Applications

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Agenda

- Calidus Engineering Ltd
- Downhole Monitoring
- Key Technologies
- Tool Developments
  - Well Head Alarm
  - Remote autonomous exploration tool
  - E-line logging
Calidus Engineering Ltd

Founded 1999, based in Redruth, Cornwall

Design, develop and manufacture of downhole and subsea systems for oil and gas and geo-thermal environments

Key technologies: camera systems, heat shield technologies, HP/HT logging tools, sealing systems, software and electronic tools,

ISO-9001:2008 manufacture

17,500 sq ft office, laboratory and manufacturing facilities incl 135 m borehole
Downhole monitoring trends

- Existing well
  - More comprehensive monitoring
  - Better quality data
  - Permanent monitoring

- Exploration
  - Easier, less costly field exploration
  - More detailed assessments

- Integrity Management
  - Environmental
  - Intelligent well systems
Downhole monitoring trends

- HP/HT
- Increasingly aggressive environments
- By 2019 – 11% of Subsea Wells will be HPHT (SLB 2008)
HP/HT Tool Development

• **Heat Resistance**
  - Thermal protection of electronics, seals etc
  - Dewar technology – reduce radiant heat
  - Geo-thermal – 400C resistance at 12,000PSI achieved

• **Sealing Systems**
  - Pressure and temperature requirements increasing beyond the limitations of traditional elastomeric seals.
  - Enhanced polymers - rapid gas decompression resistant grades - seal geometries
  - Multiple seal configuration – predictable performance ensures tool integrity and performance
• Camera and Video Systems
  Higher quality inspection images needed
  Riser and Pipeline camera systems proven inspection tools
  Downhole well casing inspection images

• Remote Monitoring Technology
  Fibre optic sensing - Real time field management, bi-directional control & monitoring
  Sensor Array Systems - i.e. multiple tools can from an array for the monitoring of a particular area in real time
  Permanent sensors - long term stable, accurate measurements

• Integrity Management
  Increasing concern about environmental effects of oil and gas drilling and production
Recent Application Developments

• Zone 0 well head alarm integrity sensors

• Autonomous Remote (rig-less) Exploration Tool

• Downhole video camera technology
Zone 0 Well Head Alarm

• A tool recovery alarm used during well intervention operations to positively locate the position of a tool string as it exits the well into the platform pressure control equipment.

• Some wells ‘closed in’ - no way of actually seeing the tool string as it leaves the well.

• Safe Operation Essential - needed to achieve Zone 0
Well Head Alarm

**Advantages of alarm:**

- Stops the tool string hitting the riser seal head
- Prevents tool string being lost down the well
- Prevents loss of well containment
- Prevents damage to completion equipment
- Prevents environmental clean up
- Limits incidents due to human error
Well Head Alarm System:

Control Unit
Magnetic Sensor Element (attaches to Riser)
Magnetic Sub (attaches to tool string)
Sounder
Hook up Cables
All items are Zone 0 certified

Certification: BASEEFA
- ATEX Zone 0
- Equipment used in Explosive Atmosphere
- IEC 60079-11
- Intrinsic Safety “i”
Subsea Field Exploration

New fields remote, difficult to access, limited weather window, no support infrastructure

Concerns about safety /environmental risk of exploration activities

Conventional exploration: Drilling Rig

- Expensive
- Time consuming
- High risk: commercial, health and safety and environmental
• Badger Explorer tool designed to explore and monitor the subsurface without the need for a conventional drilling rig

• The Badger tool drills autonomously, carries advanced instrumentation to map and / or monitor the subsurface, while closing the path behind itself to prevent oil and gas migrating upward

• Badger tool is a strategic exploration tool
Subsea Field Exploration

Purpose is to construct and qualify a high specification Badger Explorer tool and form the basis for the subsequent industrial pilot phase:

- Development of Enabling Technology
- Advanced drill bit concept
- Thick slurry storage and compaction
- Separation and compaction
- Instrumentation
- Algorithms for steering and control system

Compared to a full drilling operation, the Badger Explorer needs only a very little amount of equipment to launch:

- No BOPs required
- During operation, the tool consumes only 10 kW
In addition to traditional formation logging as the tool penetrates the ground, the Badger Explorer can provide some unique measurements:

• The Badger Explorer provides the possibility of measuring True RW, in place, in a continuous manner

• The Badger Explorer, using native formation fluid to circulate, has no invaded zone and hence no need for compensation -> True RW

• Cable integrated sensing

Standard down hole fibre can be incorporated in the cable construction, allowing for distributed sensing:

  Distributed Temperature
  Distributed Strain
  Pressure
  Acoustics
CaliCAM: E-line Video Logging
CaliCAM: E-line Video Logging

- Operational Requirement:
- Run the camera on a standard logging cable
- Provide a ‘live’ navigation image
- Switch on recording as and when required.
- Once the log is complete, return the camera to surface, and connect the download Ethernet cable. Retrieve the video log and review.
CaliCAM: E-line Video Logging

- Full HD video logging for inspection of cased wells

- CaliCAM uses a wide angle lens to give a more thorough inspection

- Entire inside of the well is recorded, rather than just one part of it.

- All images are recorded in a single run, in full HD video rather than still images, significantly reducing downhole inspection times.
CaliCAM: E-line Video Logging

- Engineers able to see 'live' images of the well, enabling visual confirmation of inspection points.

- Designed to withstand temperatures up to 125°C, the CaliCAM downhole camera comprises a colour high definition (full HD) sensor housed in a heat resistant Dewar flask.

- The 2.25” (5.7 cm) diameter tool on standard wireline monocable. Video is transmitted to the surface at 5fps over E-line. Higher resolution video is recorded on to a PC compatible, 32GB SD card, providing at least 5 hours recording, for later download via Ethernet.
HP/HT Applications

• Increasing need for HP/HT tools
• Balance of technologies optimised to meet downhole environment
• Integrity management
• Overall good performance vs specialised tools
• Key technologies: thermal protection, sealing systems, video systems, communications systems, and autonomous tools.
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