The 2nd Generation DC All-Electric Subsea Production Control System

Jan van den Akker – Cameron

JOURNEES ANNUELLES DES HYDROCARBURES 2011
Atelier 5 : Equipements Innovants SUBSEA
The 2nd Generation DC All-Electric Subsea Production Control System

Agenda

• **Introduction**
• Performance 1\textsuperscript{st} Generation
• Lessons Learnt
• Inclusion state of the art Communication
• Concept 2\textsuperscript{nd} Generation
• Qualification Approach/Status
• Summary
All Electric Subsea System

Enabler Technology for:
• **Subsea Production Systems**, which have:
  - Environmental demand for Zero discharge
  - High availability requirements
  - Extreme offset and/or water depth
• **Subsea Processing**, which needs:
  - Ultra fast control (slugs)
  - Continuous valve actuation (separator tank level)
  - Integrated Control

Model of gate valve w/ electric actuator

1st. electric tree being run on KSF Field, May 2008
All Electric “DC Technology” - Milestones

1999 DC Program Start

2004 Successful Pilot Trial (BP Magnus)

2008 Successful Start World’s 1st All Electric Production System (Total K5F)

2011 Qualified ESCCSV available, awaiting field trail

2011+ 2nd gen DC fully qualified All Electric Technology widely accepted within industry as a true alternative for traditional E/H Mux Systems
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Phase 1 Scope (installed):
- 2-off Mudline Style X-Mas Trees
- Production Control System
- Installation & Workover Control system

Phase 2 Scope (on order):
- 1-off Mudline Style X-Mas Trees
System – Overview

- Rig Power
- Anode Umbilical
- Seawater Return
- Umbilical
- Cathode
- Act 1
- Act 2
- Sensor

On K5F, 9 Tree Functions, plus 8 Sensors
Status

- System in production since September 2008
- Per September 2011, 2 recorded unplanned system/well shutdowns which were a direct result of the DC System.
  - On 06 Jan. 2009, there was a system shutdown caused by a topside component
  - On 24 Dec. 2010, there was a shutdown of tree #1 caused by a subsea component (failure investigation ongoing)
- Well 1 back in production using spare equipment, Subsea Distribution components under review
- System under constant performance review in order to learn for 2nd generation and future applications
Condition Monitoring

DC System MCS → Transfer of Field Data

Reference Data

PDA: Process Data Analysis
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Lessons Learnt

• The Subsea fail-safe Electric Actuators have performed to full satisfaction, the well was NEVER in an unsafe state.

• To original concept of CoP in combination with coax cable, does not represent state of the art technology

• Special designed electronics haven proven to be robust, but are high cost compared with commercially available components

• Separate assemblies for each channel is not required, similar approach as with traditional systems is acceptable (separate channels but in one retrievable unit)

• Selection of electric distribution components require review
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State of the art comms

- Increase data transfer rate
  - Usage of optical fibers between topside and router module
  - Usage of DSL between router module and ESCMs
- Long step-out distances (> 100 km)
- Using field proven technologies
- Flexible field layouts
- Open communication architecture
- Allow for plug & Play
Open Communication Architecture

- Based on Industrial Ethernet (TCP/IP)
  - Managed, Scalable and Expandable
  - Heavy Industry Proven Technology

- Communication Distribution Unit included
  - Conversion of FO Signal to Copper (Ethernet/DSL)
  - Distribution of Power
  - Several Sensor Interfaces (e.g. SIIS Level I / II / III and IWIS)
  - Network access for 3rd party devices

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Fiber Optic Ethernet</th>
<th>Copper Ethernet</th>
<th>DSL</th>
</tr>
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<tbody>
<tr>
<td>Speed</td>
<td>100 MBit/s</td>
<td>100 MBit/s</td>
<td>192 kBit/s</td>
</tr>
<tr>
<td>Distance</td>
<td>160+ km</td>
<td>Up to 100 m</td>
<td>Up to 36 km</td>
</tr>
</tbody>
</table>
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Concept

- EPU / MCS
- EPCDU
- A
- B
- FO 160 km+
- DSL 16 km+
- ESCM
- 32 Functions

JAH 2011

TOTAL
Layout ESCM

- Standard footprint, and locking device
- All components are inside pressure compensated oil filled housing
- Controls up to 32 functions
- Front access for power & comms input, and 3rd party sensors (MPFM)
- Integrated SEM “A” and SEM “B”
- Simultaneous multiple actuations
- Complete modular concept using pre-tested modules and wiring harness
Layout EPCDU

- Standard footprint and locking device
- All components are inside pressure compensated oil filled housing
- Converts FO signal into copper DSL, using field proven system
- Can control upto 5 ESCMs
- Top, Front and Bottom mounted E-connectors
- Synergies with E/H-Mux equipment: 50% of components are field proven.
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Qualification Status

• Single Board Q1 level testing ongoing, various components complete

• Q2 testing of various assy’s commenced, a few sub-assy’s complete

• Assembly level testing scheduled for Q4/2011
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• 3+ yrs of successful production with the 1st generation electric tree provided valuable feedback as a basis for the 2nd generation development

• Significantly increased condition monitoring capabilities are a valuable asset in comparison with traditional systems

• In order to further enhance functionality, field proven high bandwidth communication technologies have been introduced

• 2nd generation electric systems are now cost competitive with E/H-Mux

• Technology qualification process runs at full steam. Component qualification is expected to be complete by Q4/2011
Thank You

Contact

Jan van den Akker
Product Manager Controls
Cameron GmbH
Celle, Germany
jan.vandenakker@c-a-m.com
+49 5141 806 955
+49 172 545 6932