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Application of Multi-Zone Expandable Sand Screen Completion in Deepwater West Africa

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High Productivity



Presentation Contents

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Project Background

- Deepwater Subsea Project – High Profile \$\$
- Water Injectors & Oil Producers
- Poorly Sorted to Unconsolidated Sand, Highly Permeable
- Typical Development Scheme for Deepwater with Sand Type
 - SAS for Horizontal Oil Producers
 - SAS or Frac-Pack for Deviated Oil Producers
 - SAS for Horizontal & Deviated Water Injectors
- Operators Experience with Expandables Initiated in Year 2000 Assists Decision to Introduce Technology into Field
 - Frac-Pack Completions with Disappointing Productivity Results – Study Carried out to Address use of Expandables
 - Expandables Introduced Initially for Deviated Water Injectors (to Reduce Mechanical Skin & Degraded Permeability of Natural Sand Pack)
 - Success and Cost Savings Lead to use in Oil Producers
- SPE Paper 128046 (*Formation Damage Control – Feb 10*)



Expandable Completion Overview (Injectors)

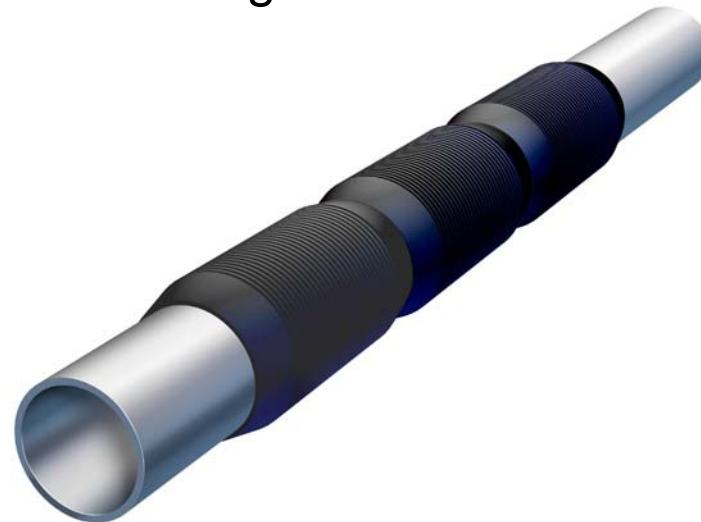
- Non-Selective Multi-Zone
- 9-5/8" 53.5# Casing Hanger
- 7" LCS (230 micron weave)
- Non-Expandable Vam Top Connections
 - Unexpanded
- 27° to 52° Inclinations
- 157m – 234m Completion Lengths
- OBM (1.12 sg)
- EZI Introduced on Last Well





Expandable Completion Overview (Producers)

- Selective Multi-Zone
- 10-3/4" 65.7# Casing Hanger
- 7" 316L (150 micron weave)
- Non-Expandable Vam Top Connections
- 29° to 42° Inclinations
- 289m – 343m Completion Lengths
- OBM (1.18 sg)





Challenges

- First 7.0” ESS® Installation Deployed in Deepwater Subsea Wells
 - Expansion Procedures from a Floating Vessel
 - Rig Capability to Achieve Reliable Compensation
- Surpass Operators High Expectations and be Comparable to Existing Sandface Completions
 - Low NPT & Low OPEX
 - Sand-free Completions
 - Injectivity /Productivity Performance
- Qualify the Expandable Zonal Isolation (EZI) – only Swell Packers Available at time
- Logistical / Security Issues



Completion Design & Testing

- Extensive Experience with Application Design
 - Traffic Light System
- Heave study Carried out by 3rd Party Jan 2007
 - Active System Would be Required to Stay Within Expansion Parameters
 - Retrofit System Added to Passive System (PS) if not Currently Fitted – Not Advisable to use PS on its own
 - Incorporate a Downhole Compensation System (Thrusters)



Completion Design & Testing

- EZI Suitability to Field Characteristics
 - 9.22” x 8.60” Oval Hole
 - 1,500psi Applied
 - 3 Complete Temperature Cycles (10°C to 107°C) 30 Minute Hold Period at Upper and Lower Temps
 - No Leakage Observed





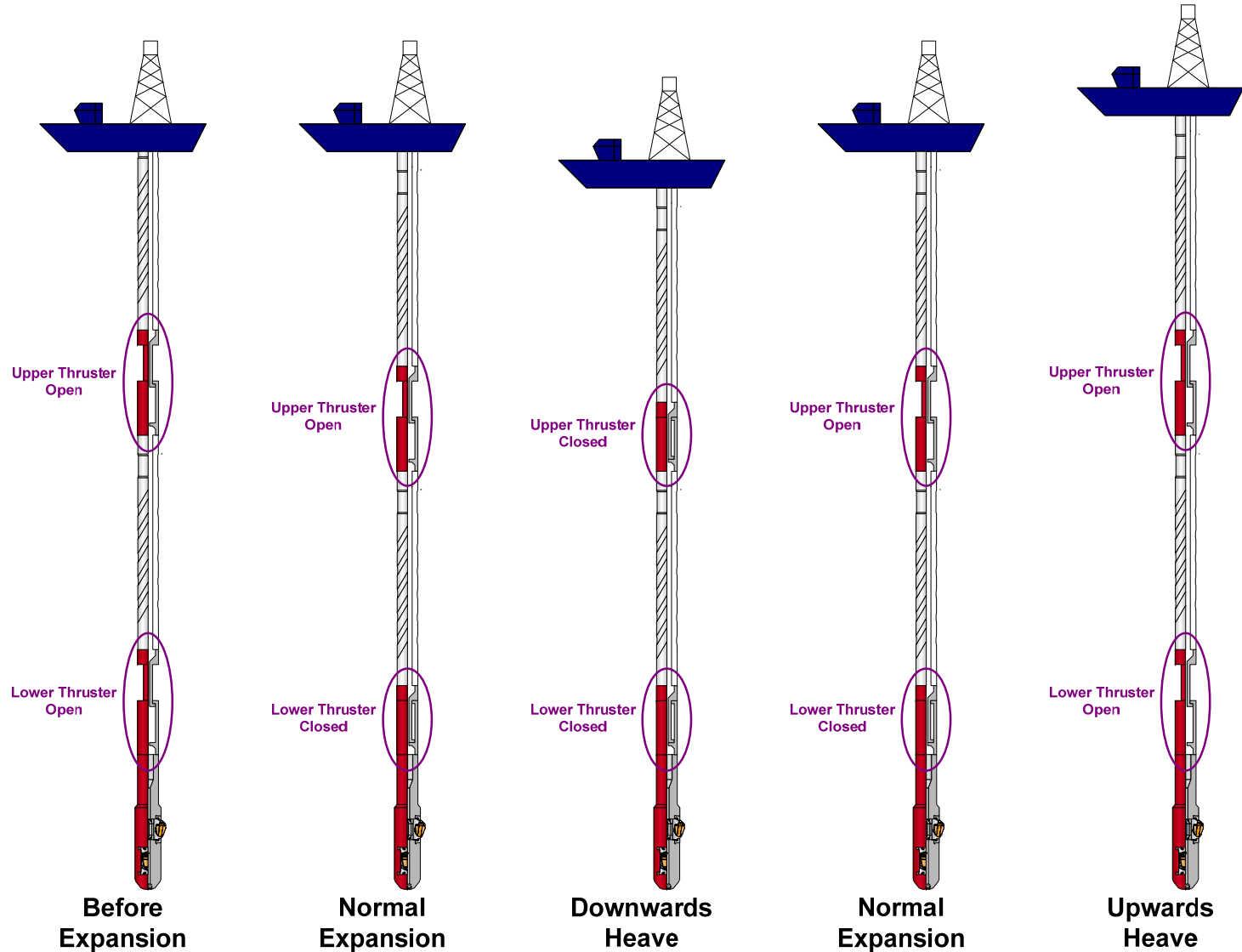
Offshore Installation

- Initial Rig Visit Resulted in Expectation of Motion Referenced Compensation to Eliminate Heave Motion [Active System] & <1m Heave
 - Procedures In Place
- Prior to Actual Expandable Installation, Passive Compensation System Confirmed, Combined With Auto-Driller & 1-2m Heave
 - Procedure Changed to Reflect Rig Systems Configuration
 - Inclusion of Thrusters Going Forward
- Thrusters Utilised on Other West African Field with Same Operator to Success
- Feasibility of Expansion Process on Floating Vessel Demonstrated Through Varying Compensation Systems





Drilling Thrusters - How They Work





Water Injectors & Expandables

- SAS Used as Base Case in Large Deepwater Projects
- Philosophy - Minimise Skin & Maximise Contributing Borehole Length
 - Achieved with Expandable Screens
- Six Wells Completed to-date, Five Injecting (18 in total for Operator)
- Initial Wells Completed as Multi-Zone (no isolation)
- Latter Wells Introduced Reservoir Isolation (EZI™)
- Typical Completion Lengths (157m – 234m)
- Well Deviations (27° to 52°)

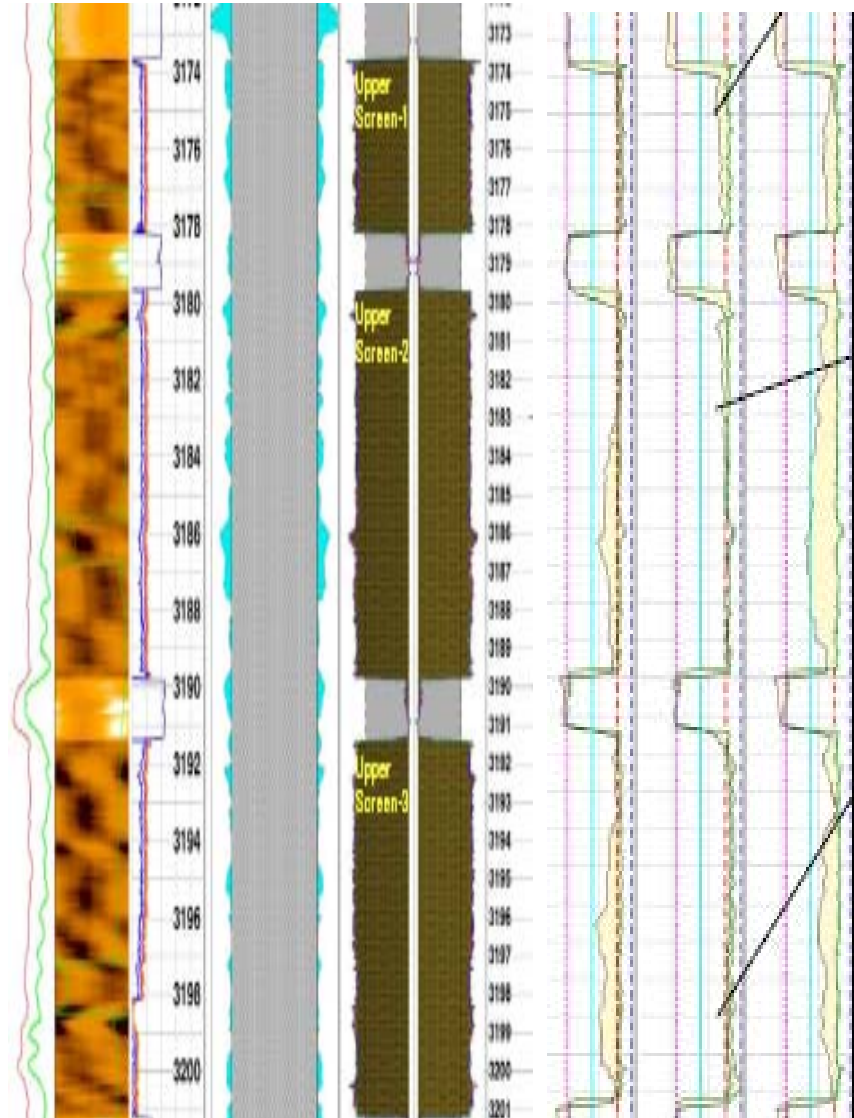


Oil Producers & Expandables

- SAS Utilised as Base Case for Horizontal Producers
- Deviated Producers Completed with SAS or Frac-Pack (*dependant on reservoir characteristics*)
- Introduction of Expandables to Producers Came About Through Disappointing Productivity Results on Traditional Frac-Pack Completions
 - Prime Drivers were Productivity Enhancement & Cost Reduction (est. \$10M per well)
 - Operational Success on Injectors
- Open Hole Completions with Zonal Isolation

Performance

- 5 Water Injector Wells, Each Injecting at ~50 kbwpd After 8 Months
- Production Wells Low Skin and 10 kbopd
- NPT <5%
- “Outstanding achievement that is the result of a rigorous preparation and an excellent cooperation of your team”
- UBI-EMS-Logging Tools Confirm Compliance





Summary & Conclusion

- All Challenges Met to Date
 - NPT < 5%
 - Sand Free Injection & Production
 - Cost Reductions (\$10M per Well compared to Frac-Packs)
 - Injection Rates ~50 kbwpd, Oil Producers Low Skin & 10 kbopd
- After 11 Deepwater Applications for Expandable Screens, Technique Considered **Field Proven, Cost Effective** and **Efficient**
- Field Applications Growing on Other Deepwater Projects in WA
- Technology is Often Questioned but Communications on Subject are Rare - *Conferences*
- Reliability Confirmation will Come with Time
- Expandable Screens are a Solution in Varied Applications and Should be Introduced Through Correct Application & Design



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Thank you for your attention

Please feel free to ask any questions

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