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Unbonded Flexible Pipe with Embedded Electrical Cables for Riserless Light Well Intervention

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NH GRAND HOTEL KRASNAPOLSKY • AMSTERDAM • 3-5 APRIL 2017

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Riserless Light Well Intervention Overview

- Well intervention concept improves oil recovery by performing different types of well works
 - From 30% UOR (normal production) to 50%-70% UOR with well intervention (International Energy Agency)
- Riserless Light Well Intervention (RLWI) uses intervention vessel instead of drilling rig
 - Increase recovery rate of subsea fields with minimum downtime and expenditure
- Use of unbonded flexible pipe for RLWI (polyvalent tool for addional subsea work)
 - Typical applications for RLWI
 - Acid stimulation
 - Scale squeeze
 - Hydrate remediation
 - Flowback

- Other applications for subsea interventions
 - Well kill
 - Injection test
 - Flowline flushing/circulation
 - Flowback
 - ...Any hydraulic jobs





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2.5" High Pressure Acid Line Qualification







2.5" High Pressure Acid Line Qualification

- 2.5" high specification flexible pipe incl. 8 electrical cables
 - 10kPsi / 1500 m WD / 65°C / Chemicals
 - Designed for empty conditions & fatigue
 - Electrical flat cables for valves activation
- Multiple deployments & recovery (20 / year) over 10 years
- Independent Review Certificate (API 17 J compliant)
- Specific Offshore Inspection & Operating Manual
- Specific qualification tests program
 - Electrical Cables
 - Electrical Connectors
 - Flexible structure & deployment



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Integrated Electrical Cables - Qualification

- Use : Control / monitoring of the injection skid system
- Moderate voltage & low intensity
- Tensile resistance for armouring process
- Resistant to hydrostatic pressure, lateral contact with armour wires & fatigue in operation
- Repairable in manufacturing
- Dedicated qualification



aying of the cable onto the flexible pipe Integration within Flexible Pipe	•	Manufacturing of a 100 m prototype (Full Scale) Tensile Test	
Subsea Application	•	Hydrostatic Pressure Test on individual conductors Aging	
Deployment & Operation	•	Spooling/Unspooling Full Scale Test (including dissection)	
		Lateral Crushing Test	









Full Scale Prototype & Test

- 100 m long flexible downline prototype manufactured
 - Integrating electrical cables & connectors
- Test to simulate the behavior of the flexible during the deployment/recovery phases
 - Representative full scale set-up
 - 400 cycles successfully executed
 - Continuous follow of integrity of pipe & electrical components (TDR)
- Dissection confirmed good performance









Subsea Intervention System - General

- Succesfull design and qualification compaign
- Field proven and mastered unbonded flexible technology
- Extensive knowledge dynamic and fatigue analysis of subsea systems
- Track record in well intervention for acidizing jobs
- Experience in Subsea Installation (apparatus and procedures)

CoflexSIS (Coflexip® Subsea Intervention System)





Subsea Intervention System - General



- Versatile deployment system A compact system to deploy the flexible pipe
 - Portable and modular skid
 - Installable on small monohull vessels
 - All-in-One Solution
- **Downline with integrated buoyant section** Reelable buoyancy modules for a pliant wave shape
 - Resistance to deployment/retrieval cycles
 - Enables heave compensation
 - Self-supported pipe for fast deployment

Adaptable seabed package Sofe connection according to project one

Safe connection according to project specifics

- Break-away system
- Lowering of injection skid / tool by the flexible pipe
- Subsea jumper between injection skid and wellhead

Subsea Intervention System – Flexible Pipe and Ancillaries



- Unbonded flexible pipe : Polymer & Metallic layers
- Electric cables can be included
- 2" to 4" up to 20 kpsi self supported contineous length
- Smooth bore technology to increase flowrate
- Collapse resistant beyond 3000m WD
- Service Life : Predictable fatigue & multiple deployements

- Continuous Reelable buoyancy system
 - Permanently mounted on the downline
 - Spooled on the upper layer of the reel
 - No need for installation & removal during deployment & retrieval



Image courtesy of Maritime Development Ltd

Chute between reel & tensioner 13 m Reel for 2kms 2.5in 12Kpsi 12 m 9 m Tensioner: 75 Tonnes capacity **Estimated Weights:** System empty without flexible pipe: Max of 175 T Flexible pipe: 70 T (2.5in **Reel Driving System** Structural Frame to support 12Kpsi 2000m) tensioner & chute

Subsea Intervention System – Deployment System

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Subsea Intervention System - Alternatives

 Alternative using separated tensionner and chute



deploy the unbonded flexible pipe

Alternative using the crane wire to

 Alternative using coiled tubing and unbonded flexible



Image courtesy of F.lli Righini srl

- Reduce deck footprint
- Use of existing assets
- Tailored solution as per client specification

- Ree Ree
- CAPEX and OPEX combination
 - Emergency response

Smaller water depth

Conclusion

- Unbonded Flexible Pipe Downline performing 3 functions in 1
 - Convey fluid
 - Withstand subsea injection skid/tool weight during deployment & recovery
 - Control injection skid via integrated electrical cables
- Qualified system & suitable technology
- All types of subsea intervention applications
- Quick & efficient deployment leading to cost-effective solution
- Alternatives available to suit every fields and configurations

Questions?







