EOR – Opportunity for HWO

Keith Henning
Global Advisor
Overview

- Mature fields and HWO
- Improvements in safety and processes
- West Africa success story
- Risk reduction and value added
Mature Fields

70% Amount of Worldwide Oil & Gas Production from Mature Fields

35% Average Worldwide Recovery Factor for OIL

1% Recovery Factor Increase Needed for Additional Two-year Global Oil and Gas Supply
A Mature Field is not defined by it’s age

... but where it is relative to Peak Production
Untapped Opportunity…The Right Side of the Curve
The Value of Mature Fields

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<th>Category</th>
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Good Cash Flow at Good Returns
Symptoms of Production Decline

- Pressure Drop
- Sand Production
- Water Production
75% WORLDWIDE AVERAGE WATERCUT
Issues With Water Production

Sand Production

Scale

Corrosion
Understanding Problem and the HWO Solution

Define the Client SOW

Select and Design Solution

Initiate field sustaining or EOR Program

Understand cost drivers
Major Issues affecting clients

- Platform sizes vary from small WHP, to monopod, to large NS platforms
- Crane capacity downgrade / no crane
- Deck loading limitations
- Regulations for lifting, emissions, zoning, etc
- Access/tower requirements
- Logistics support
- Water depth
- Cost....
What are the needs

- Be able to have equipment which serves 80% of the market
  - Live well operations – mainly on land
  - Workover mainly offshore market – with ability to drill short radius sidetrack
- Be able to work with limited crane heights
  - Down-rated cranes
  - No cranes
  - Use of barge cranes
- Reduction of risks of working at height
- Keep mobility without reducing efficiency
- Retain lower cost model to optimise returns in mature assets
- Keep the drilling rigs turning to the right!
Client Issues

- Mature field cost drivers
  - Uneconomical for jack-ups to be pulled off drilling programs
  - Interruption to the drilling schedules when moved to bring well back on line

- Using the HWO service in same manner as the drilling operations to optimise and drive operational efficiencies
  - needs dedicated management by drilling/WO team not completions teams

- Support long term contract engagement to maximise the economics
HWO Portfolio
Design Enhancements to Snubbing Unit Surface Equipment Delivers Improved Operational Efficiency and Safety
Slip Interlock Safety System

Assures that one slip bowl is always closed on the pipe.

The system prevents:

- **Operator error**
  - Accidentally opening a slip bowl

- **Slip Bowl Mechanical Failure**
  - Failure of the slip bowl to fully close on pipe due to mechanical or hydraulic fault.

- **Off set Closure**
  - Slip bowl fails to close fully due to bowing (buckling) of pipe within the slip bowl.

- **Loss or reduced slip bowl hydraulic pressure**
  - Internal leakage with the slip bowls hydraulic actuator cylinders.
  - Loss of a pump pressure
  - Quick disconnect problems

- **Closing slips on tool joint.**
Slip Interlock

**TRAVELING SLIP**

- POSITION SENSOR
- PRESSURE SENSOR

**CLOSE:**

- OPEN SLIP

**STATIONARY SLIP**

- OPEN SLIP

**PROTECTS AGAINST:**

- OPERATOR ERROR
- OFFSET BITE
- MECHANICAL FAILURE
- HYDRAULIC PRESSURE LOSS

**SLIP STAYS CLOSED**

**BLOCKED**
Offshore vs. Land Market
Equipment Optimization Considerations

- HWO stand alone unit designs are typically:
  - Modular and light weight
  - Designed for broad market access
  - Mobility satisfies many offshore physical challenges / not an advantage on land.
  - How to improve land rig up efficiency w/o impacting offshore mobility
Packaging Enhancements Improve Rig Up Speed

A) Quick Rig Backbone
B) Jack
C) Gin Pole
D) Work Basket
E) Stationary Slip Bowls
One Lift Replaces 6:
- Slip Window Lift
- Jack Lift
- Work Basket Extension
- Work Basket Lift
- Gin Pole Lift
- Counter Balance Winch Lift

Eliminates 75% of Hose Connections
Lift/ Rig Up Efficiency – Bringing it to the rest of the rig set

BOP Configuration:
- Annular BOP
- Stripping Ram BOP
- Spool
- Work platform
- Stripping Ram BOP
- Safety Ram BOP
- Safety Ram BOP

Pivot Transport Skid

Light workover mud system
- Modular 600bbls mud system
- Can be used onshore in trailer mounted QR mode
- Offshore as skids – 6 lifts
Gin Pole Pipe Guide

- Enables Pipe Make up at wind speeds up to 20 m/sec (44.7 mph)

- Max wind speed without the guide: 12 m/sec. (approx 27 mph)

- Enable HWO unit to operate up to same wind conditions as cranes.

- Pipe sizes: 2-3/8” – 7”
Offshore Congo: Developing Low Quality Pay Economically
HWO : Critical points to consider

- Lessons learned from 10 years operations in West Africa:
  - Light weight Modular Crane, platform mounted is the safest/most efficient solution for enhanced Rig-up/Rig down and moving time
  - Right sizing of equipment to fit SOW is key to avoid oversizing and reduce operation in-efficiency
  - Only use Structure type tower/racking only where needed - Drilling
  - Right sizing of fluid system to fit SOW is Key for successful re-entry project
HWO : Critical points to consider

- SOW mainly planned on 20x24 meters platform equipped with 5-10t MAPE crane:
HWO: Critical points to consider

- Key difference / upgrade for Drilling re-entry versus Workover
  - High torque / High speed rotary Table required
  - Unit with full stroke at high torque
  - 3” treating line
  - Right sizing of mud pumps:
    - Plunger size and HHP.
  - Higher fluid system storage capacity
  - Pulsation dampener to minimize interference for DD data
  - Surface solid control and gas control
  - BOP stack design

Drilling Solid control and gas control upgrade example
Re-entry Supply vessel/Barge main equipment

- **Mud system**
  - Mixing tanks, active tanks, storage tanks, Centrifugal Skids.
  - Volume capacity depending on minimum requirement of customer.
  - HP mud pumps:
    - 4-1/2 ” plunger and 6” plunger
  - 3” pumping treating lines with Quick disconnects
  - Filtration

- **Crane**
- **Dry chemicals Silos**
- **Cement unit**
- **Generators/Compressors**
- **Offices**
Typical Operations Performed

- Completion change-out
- TCP deployment
- CT
- Acidising
- Cementing
- Milling
- Infill Drilling ≤500m

Typical workover operations performed 14 days per well
- Rig up/down 48hrs
- High efficiencies obtained through repetitive operations on long term contract
## Drilling Statistics – 2006 to 2013 – 12 wells

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- New campaign starting West Africa Q2/14
Expanding the Boundaries for HWO

West Africa Case History
Target Area
Background

- High Oil in Place: ~1 Billion Barrels
- Clients have existing Infrastructure
- Scarcity of Technical Staff within client operations
- Maximising the returns on NOC partner license
  - Challenge to IOC’s to improve production
- Existing integrated service offering in region
  - Allows for full suit of service offering through IPM approach
Challenges

- Low Well Productivity
  - Low Reservoir Pressure
  - Poor Permeability (<10 md)
  - High Water Saturation
  - Low Gravity, Waxy
- Limited Reservoir Data and Wells
- No Clear Analog to Other Reservoirs
- Platform restrictions
Solution: An Integrated Field Development Plan

1. Re-evaluate the Subsurface
2. Identify Development Opportunities
3. Detailed Project Planning
4. Use HWO as workover rig to perform remedial workover, including fracturing
Risk Reduction and Value Added
Risk Reduction

- Long term securing of ‘rig’ equipment set
  - Ensure availability of equipment to workover ESP’s where mean time to failure known – 3 to 36 months?
- Reduced cost to clients over call off market
  - Dedicated package available for field sustaining and changeover to EOR completion strategy
- Dedicated equipment built fit for purpose for market needs
  - Standardized offering to meet 80% of market needs
- Move toward removal of human interfaces in the work basket
  - Automisation
  - Bringing the equipment into the 21st century
Value Added

- Ability to enhance service provider ROI through higher equipment utilization
- Conversion from Offshore to Onshore Quick Rig set up
  - HWO & Mud systems to serve both markets at reduced cost with improved efficiencies
- Use of rig sets for workover and short infill drilling programs
  - Proven to be economical for niche markets – 500m max optimum
- Core service provision in workover mode
  - Working offshore in hoist mode 50% of current business globally
- Operators keep drilling rigs turning to the right in high cost mature markets
Current Issues

- **Old Technology**
  - Need to move the hydraulic control systems forward through use of electro-over hydraulic systems
  - Reduction of the human interface
  - Keep the weight under 16,000lbs for offshore lifts
  - Meet the needs of both onshore live well market and offshore workover market

- **Business model**
  - Traditional HWO providers in response mode for short term contracts
  - Clients looking to secure the equipment on longer term contracts allows for the investment and ROI on major capital asset program
  - Focus to build from centers of excellence
From Discrete Services To Integrated Projects

Discrete Services

Integrated Solutions

Global HWO Presence

MANY Service Providers

UNDER 10 Service Providers

Only One Service Providers
HWO in Mature Fields…takeaway

**MARKET OPPORTUNITY**
Long term rig contracts benefiting both client and service provider

**MARKET GROWTH**
Mature offshore fields operating in workover mode

**TECHNOLOGIES & SERVICES**
Can be integrated in full service offering as part of EOR strategy

**HIGH RIG COST/UTILISATION**
Economic alternative when integrated to long term field management plan
Challenges Facing Wireline Valve Design

Jonathan Brown, Group Engineering Manager
Drivers for Change

- Challenges facing Operators…

- Need for greater confidence that well interventions can be stopped and shut-in quickly during an emergency

- More extreme well conditions – higher pressures

- Industry focus on integrity and safety

- All combine to push the functional specification envelope of Well Intervention equipment
As the industry moves to higher operating pressures, the traditional design of wire-line valve cannot be actuated manually.
Challenges Facing Wireline Valve Design

Design Input Discussion

Product improvement requires…

- Reduce wireline valve closing times
- Manual over-ride if there is a hydraulics failure
- No design standard or code for Wireline Valves
- Industry uses the following for guidance…
  - API-16A, API-16D, API-6A, Norsok D002, etc
- Higher operating pressures
- The design must be retro-fittable to existing equipment
Challenges Facing Wireline Valve Design

Key Design Requirements

• Provide ability to manually close the valve if there is a loss of hydraulic pressure

• Reduce valve closing times to API16D
  • Produce a design that overcomes the imbalance that well head pressure to hydraulic pressure creates
  • The design must increase the efficiency of the hydraulic system

• Ability to retrofit on existing wireline valves, all sizes and pressure ratings
Ezi-Close Testing Results and Improvements

Reduced actuation pressures / torques
• Ezi-close can be manually closed at any well pressure up to MWP of WLV
• Traditional design is not operable by hand at higher pressures

Reduced closure times
• Ezi with 10ksi WHP = 9.3secs, 7.8secs and 8.1secs*

*with 3ksi accumulator witnessed by BV
Design Features

Pros
• Pressure balanced system that can be hand operated easily with 10ksi well head pressure
• Much improved closing times helped by the reduced friction on the system (specific seals & tolerated design)
• Well fluid isolated from actuator internals

Cons
• Field redress of the actuator is not recommended
Challenges Facing Wireline Valve Design

Project Summary

• Project started in 2011
• Product commercial in September 2012
• 15 WLV sold so far and are being used in our rental fleet
• Production is ongoing
Ezi-Close Actuator Summary

• No emergency actuations to report to date

• To extend products to 15ksi, 20ksi and beyond the Ezi-Close Actuator is the design of choice due to closing times and manual over-ride
Challenges Facing Wireline Valve Design

Jonathan Brown, Group Engineering Manager
Overview of Texas Oil Tools

Coiled Tubing Well Control
Work Over Well Control
Snubbing Well Control
Company Profile

- Headquarters Conroe, Texas
- Lafayette, Louisiana
  - Sales
- UK
  - Sales, Recertification, and technical support
- Dubai
  - Sales, Recertification, and technical support
- Singapore
  - Sales, recertification, and testing
Product Range

- Bore Sizes 2.56” – 7.375”
- Working Pressure 3,000psi – 20,000psi
- Service Range:
  - Standard H₂S -32°C (-25°F) – 121°C (250°F)
  - North Sea H₂S 3rd Party Certified -37°C (-35°F) – (121°C) 250°F
  - Arctic -46°C (-50°F) – 93°C (200°F)
  - Geothermal 5°C (40°F) – 260°C (500°F)
Subsea BOP for Well Intervention

7.38 10ksi Subsea Dual Combi

5.12” 15ksi Thunderhorse Project
An introduction to EEEGR

Offshore Well Intervention Conference, Europe 2014
EEEGR Catalyst for the Energy sector

Not for profit Trade organisation representing the interests of the energy sector and its supply chain in the East of England

East of England Norfolk, Suffolk, Essex, Beds., Herts., Cambs

All Energy Oil and Gas, Nuclear, Renewables, Bio

Unique area in England Only region in England with all these forms of energy
About EEEGR

- **400 members** From Shell, GDF, RWE, Statoil Tier 1’s to small independents
- **Varied portfolio of activities** Events, Lobbying, Skills, inward investment, Special Interest Groups, publications and guides, business intelligence and research
- **Whistle-stop tour** A few of our activities and programmes
  - Skills for Energy
  - Supply chain support
  - SIG’s
  - Events
  - Working with government
Skills for Energy (SfE)

Core programme Industry led. Centred on addressing core skills needs across all energy sectors, both technical and commercial, achieved through collaborative partnerships.

Supported by ECITB Close co-operation and joint working

Highlighting a few of the SfE Initiatives

- Energy Skills Foundation Programmes
- Degree Programme
- Energy Employment Advisor
- Military in Industry
- Education and Training Provider Network
Skills for Energy (SfE)

- Energy Skills Foundation Programme: An NVQ level 2 "pre-apprenticeship"
  - 5th year at Lowestoft College and 2nd year at Great Yarmouth College
  - To date 65 students that have successfully completed.
  - 100% Employment record
Skills for Energy (SfE)

Degree Programme working with the University of East Anglia delivering:
- MSc in Energy Engineering with Environmental Management Third year of delivery with 100% employment
- BEng & MEng degree programmes launched in September 2013. Delivered by UEA and Lowestoft College.
Skills for Energy (SfE)

- **Military in the industry** SfE acting as Facilitator to enable those with the relevant skills to gain access to the sector

- **Military Industry network** – identifying those in the industry that were formerly in the services and utilising their knowledge and experience for new leavers and ex-military

- **Industry awareness events** CV workshops and advice, interviewing skills, support linked In group etc.
Skills for Energy (SfE)

- Energy Employment adviser Working with Job Centre Plus
  - Matt Knights
  - One year contract
  - Initially Yarmouth & Lowestoft
  - Wading through over 5,000 CV looking for any potential skills that could be used in the industry
  - Assisting employment advisers on what industry is looking for
Skills for Energy (SfE)

- **Education and Training Provider Network** Public & private sector including: UEA, Petans, 6th form colleges
- **Goal:** Improving ability to support the industry & promoting the capabilities of the providers.
- **New:** This is a special membership category within EEEGR
- **Deliverables:** Apprenticeship guide from BTec’s through to degrees. The full career pathway.
- **Training brokerage:** Aggregating industry demand and seeking solutions.
  - e.g. Industry introductory training
Supply chain support programme

Three complementary approaches to develop our supply chain.

- Support businesses that have already secured opportunities within the sector
- Engage with businesses planning to enter the market and help them to understand the industry.
- Explore opportunities for companies unaware of the sector
- ERDF Funded. You can access this support completely **FREE** through EEEGR 01493 446535 or email supplychain@eeegrr.com
Special Interest Groups (SIG’s)

- **Decommissioning SIG** Been going since July 2012 meets 4 PA April 29th NCFC
- **Nuclear** New build and decommissioning. Autumn / Winter 2014
- **Offshore wind** Announcement in Early May with TOR
- **Oil and Gas Promotional Group** Peter Aldous MP
- **Others being considered**
  - Unconventional oil and gas,
  - Wood review – Maximising Economic Recovery in SNS
  - Fabricators forum,
Events

Two flagship Events SNS and All Energy Conferences and exhibitions.

- **SNS2014** March oil and Gas, Offshore wind gala dinner with Energy Minister Michael Fallon

- **EEEGR2014** All energy conference with diverse speakers inc. Shadow minister, Unconventional oil and gas, nuclear decommissioning, unconventional generation, solar

Other events Networking Breakfasts, meet the Buyer,
Working with government

- East of England long overlooked Nice place to have a holiday - you guys just grow sugar beet don’t you?
- New Anglia LEP Replaced EEDA. Successful joint working. New Strategic Economic plan ‘NALEP and EEEGR have worked together to create a model of joint working in the East that could become a national exemplar’
- Working hard to gain recognition Local MP’s, BIS, DECC, DCLG, Treasury
- Shadow ministers need to be aware too Greatrex speaking at summer conference
- Message beginning to get through recent visits from PM, Chancellor, Cable, Fallon – Here are his thoughts on the region
Michael Fallon at SNS2014
Thank you

Simon.gray@eeeg.com