Multilateral Solutions
Welcome PPEPCA Delegates

November 3\textsuperscript{rd}, 2008
Islamabad, Pakistan

Tim O’Rourke - Multilateral Manager, Middle East and Asia
Arshad H. Palekar - Geology Domain Champion – Pakistan
What is a Multilateral Well and is this new and emerging technology?
Multilateral Technology and some patents

- 1929 – Leo Ranney rudimentary attempts MLs. He drilled a 2.44 m vertical shaft in Ohio, put men and equipment in the bottom of the hole and they dug horizontal holes— he also drilled in a horizontal radial pattern, “spokes of a wheel” perhaps creating the 1st ML ever.

- In the 1940’s John Zublin drilled horizontal drain holes for operators in Calif.

- In 1945 Mr. Zublin eventually re-enters 250 wells in Calif., West Texas and Wy. Averaging 2 laterals per well

Figure 1. The first multilateral technology patent was filed in 1929 and was followed by additional patents. (Images courtesy of TAML)

Information courtesy Hart E&P Mag Aug 07 & Julie Bonner, Chairperson TAML
ML’s are Not New

1939 – Alexander Grigoryan graduated from Azerbaijan Industrial Institute.

1941 – He drilled, what is on record, the world first directional well (Baku 135) using only Turbo Drills.

This directional well led to him to develop a way to increase of production in the same way a “tree root extends to soil”.

* In 1953 he drilled (66/45) 9 branches, each leg 80 to 300 m without whipstocks or cement plugs
* Increased exposure to the pay zone by 5.5 times
* Increased production by 17 times

110 wells followed from Eastern Siberia to the West Ukraine near the Black Sea.

Information courtesy Hart E&P Mag Aug 07 & Julie Bonner, Chairperson TAML
Rapid ML System’s Simple Solutions
Rapid ML System’s Simple Solutions
WHO and What is TAML? (Technology Advancement of Multilaterals)

Convened in March of 1997 – Eric Diggen Shell

“To promote the efficient development and utilization of multilateral technology within the international petroleum industry through education, dialogue, and information exchange”

Today's Members – 17 Operators, 8 Service Companies

http://www.taml.net/

Welcome to TAML

TAML's Mission

"To promote the efficient development and utilisation of multilateral technology within the international petroleum industry through education, dialogue, and information exchange."

TAML Objectives

- Advance the knowledge of multilateral technology
- Act as a collaborative resource to the industry
- Expand TAML’s role within the industry
- Facilitate information exchange
- Oversee the multilateral classification system
- Develop synergies with complimentary technologies such as intelligent completions and expandable tubulars
- Increase membership participation

Rapid ML System’s Simple Solutions
What are the TAML Classifications

Level 1
Open hole mainbore
Open hole lateral

Level 2
Mainbore cased
Open hole lateral

Level 3 - Mainbore cased
Mechanical support in the lateral

Level 4 - Mainbore and lateral cemented

Level 4
Level 5 - Hydraulic isolation at the junction

Level 5 - Pressure integrity within the junction

Level 6 - Pressure integrity within the junction
Saudi Aramco – Typical Well

1996
3,000 B/D
1 km
Saudi Aramco – Maximum Reservoir Contact (MRC’s) up to 30K’ of pay

2002
10,000 B/D
12 km
Multilateral Well without Flow Control

9-5/8" Casing

7" Production Packer

7" Liner

6" Open Hole

7" ICC

6" Open Hole

6" Open Hole

7" ICC

Schlumberger Public
The Future MRC’s to ERC’s

“Extreme Reservoir Contact” 50K’ to 75K’ in the pay

Current MRC (Maximum Reservoir Contact wells) Wells

Future ERC (Extreme Reservoir Contact) Wells
CASE STUDIES
Saudi Aramco First TAML Level 3 Tri-lateral with Sand Control Completion

TAML Level 3 tri-lateral with Sand Control application for Saudi Aramco

SPE-117518
Conclusions Impact and Cost Savings:

- Promising performance during the initial clean up (3500 BPD).
- Further clean up is ongoing to get the final production rate.
- Three (3) Single Re-Entries Vs. One (1) Tri-Lateral Re-Entry
  - Saving $1,5 MM and 70 days rig time.
  - ESP, Surface equipment
- Alternative Tri-Laterals System (Level-4)
  - Saving $150,000 and 3 days rig time.
- Tri-Lateral Re-Entry in Central Arabia can achieve a significant saving in cost and rig time for the entire project.
- TAML Level 3 reduces operation risk involving Tri-Lateral Re-Entry.
- The second well of this pilot project is planned toward end of year before final decision of replacing single re-entries to multi-lateral re-entries in this field.
Case Study (PICKERILL FIELD)
S. W. Bokhari et. al., SPE 38629

Location: UK Southern North Sea
- Discovered in 1966
- Produces from the Rotliegendes Formation, Leman Sandstone
- ARCO was the Operator in 1996
- GIIP 900 BCF
- Proven reserves 550 BCF
- Top 2 of the 6 zones were tight
- Substantial un-produced GIIP in top 2 zones
  - Avg Porosity: 12%
  - Avg. Permeability: 0.1-0.5 md
  - Initial pressure: 3995 psi
  - Temperature: 204 deg F
  - Depth: 8900 ft TVDSS
Case Study (PICKERILL FIELD)
S. W. Bokhari et. al., SPE 38629

- A3 was suspended due to very low gas production rates (<1 mmscf/d) and water handling concerns
- In 1996 (after 30 years production), BHP was taken in this well to determine if there was any depletion due to production from other wells within fields
- Results showed that the top two tight zones were at virgin pressure (deeper zones were below GWC at this location)
- Simulation model showed multilateral well could produce initially at 15 mmscf/d and recover an additional 15 BCF of reserves
- In the Summer of 1996, ARCO drilled its first multi-lateral well in Southern North Sea at A3 as A3ZY
Case Study (PICKERILL FIELD)
S. W. Bokhari et. al., SPE 38629

- Dual laterals were successfully side tracked and produced with an average rate of 18 MMCFD – performed better than predicted (estimated recoveries of 25 BCF)
- A3ZY well had not produced any water till the time SPE paper was published
- This was the first applications of multilateral technology in the UKCS by ARCO and the knowledge gained from this work resulted in developing several additional tight gas reservoirs using multi-laterals

![Graph showing cumulative production from 03/08/96 to 31/03/97. The graph indicates a cumulative production of 4.4 BCF.](image-url)
Conclusion & Recommendation

Following are the prerequisites for Horizontal & Multilateral wells:

• Recoverable reserve volume
• 3D seismic; top/bottom and extent of the producing layers
• Established Oil/Gas and water contact
• Incase of Carbonates:
  - Fracture network maps; orientation, distribution and density
• Incase of Clastic:
  - Reservoir Characterization; porous permeable layers and their productivity
• Geomechanical earth model:
  - Stress directions & quantification, rock strength analysis
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**Features**
- Improved wellbore access
- Reduced trip time
- Enhanced production performance

**Applications**
- Horizontal and inclined wells
- Steeply dipping formations

**Advantages**
- Increased operational efficiency
- Lower cost per foot of lateral

**Images**
- Pipeline with RapidAccess technology
- Drillstring in action
- Well completion with RapidConnect

**Contact**
- Schlumberger.com
- Sales: info@schlumberger.com
Thank You!

Question