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Horizontal Well Downhole Dynamometer Data Acquisition

Project sponsored by ALRDC
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Project Goal & Overview

- Gather true measured data on both deviated and horizontal rod-pumped wells
  - Actual downhole load & position (i.e. dyno cards)
- Provide that measured downhole data to industry
  - Improve our understanding of side loads, bending, friction, damping, and other factors resulting from well deviation
- Similar to the Sandia project from the mid 1990’s, but focused on deviated & horizontal wells

Paper: Insights from the Downhole Dynamometer Database - 1997
SPE Paper #37500
And a number of SWPSC Papers
Historical Perspective - Sandia

- Gathered and published data from multiple test wells
- Project took place during a period of low oil prices
- Proved wave equation methods are sound and accurate

- But… This only holds for vertical wells
- Number of well drilled since 1995 (Sandia)?
  - How many of those wells are straight holes?
The Problem

• We were promised this

• But are too often seeing things like this

• Why?
  – Deviations, friction, etc.
  – Everything Sandia didn’t test
Design vs. Analysis

• But Rodstar & SROD let us design deviated wells…

Design: Start with an estimated pump card, then calculate the surface card

Analysis: Start with a measured surface card, then calculate the pump card

Design software does this “reasonably” well

Analysis software doesn’t do this for deviated wells
**Design: Which is the deviated well?**

- Same well, only difference is the design deviation
  - One is “deviated” the other is “vertical” – Which is which?

**Ignore Peak & Minimum Loads**

What can you tell about the shape of the surface cards alone?
Analysis: Which got the calculation right?

- Pump cards are good indicators of correct methods
  - An unreadable pumpcard generally means bad input
  - OR unaccounted-for dynamics in the calculations

Wellbore friction and fluid dynamics are not accounted for

A “legible” pumpcard usually indicates good inputs and methods
How Will Measuring Data Help?

- Mathematical models need to be validated
- The frictional components in deviated wells are not thoroughly understood
  - Measured data improves that understanding
  - Lets us validate our models or develop new ones if necessary

Gather True Downhole Measurements

Critical Validation Step

Compare Against Calculated Data

Update & Improve Model

“Assume No Friction!!!”
The Project – Overview

- Design & build downhole dynamometer tools
- Deploy those tools in deviated & horizontal wells
  - Multiple tools throughout the rodstring
  - Retrieve the tools, download the data
- Validate & maintain data in an accessible\published format
- ALRDC’s role is to:
  - Provide “seed” money to initiate this project
  - Generate specifications for both the dynamometer tool & well test procedures/data to be collected
  - Gather industry support and financing
  - Ensure this measured data enters the public domain
A bit more detail – Downhole Dyno Tool

- ALRDC will provide seed money for initial stage of tool design & development
  - Design expertise & development resources welcome
- Placed along the rod string, tools store data on-board
  - Location and number of tools to be determined (approximately 8 tools per well)
- Sensors:
  - Synchronized clocks – for correlating data across multiple tools
  - 3 axis accelerometer – position & relative gravity vector
  - Multiple load cells – linear loading, plus bending and compression
  - Pressure, temperature, vibration, etc.
A bit more detail – Test Wells

- All distinct categories of deviated wells
  - Vertical (for control test), Slant, “S”, and Horizontal
- Tools will log data at various points along the rodstring
  - Logged data will verify predicted/diagnostic values
- Vary stroke rate – test slow & fast pumping speeds
  - At low speeds, the frictional forces should be more evident
- Potentially test for other variables (to be determined)
  - Utilize the same well, but vary other physical parameters
  - Time and resource permitting
Industry Support

• Developing & manufacturing downhole electronics is an essential part of this project
  – Need industry financing and/or volunteer expertise

• Need deviated & horizontal test wells
  – Wells & workover resources to be provided by Operating Companies
  – Data will be stored on the tools, which will require pulling the well
  – Detailed well files need to be provided and will be made public (well names can be redacted)

• Project & data management resources
Operations Group

• ALRDC can not sustain this project alone
  – It can get the project started, but a formal organization needs to be established to ensure its ongoing success
  – Industry, Academia, National Labs, etc.

• Operations Group Functions:
  – Implement the ALRDC recommended specs & test procedures
  – Coordinate financial resources and expenditure
  – Coordinate industry participation
  – Ensure timely execution of tests and collection of data
Rough Project Outline

ALRDC will provide resources to get this project started

Tool Design & Project Specs.

Build & Lab Test Prototype Tools

RFQ For Tool Manufacturing

Build Tools

Deploy Tools, Record Data

Significant Well & Facilities Resources

Industry financial & management support needed
Conclusions

• Improved downhole models can result in significant operational expense reductions
  – Better decisions and well designs
  – We can’t eliminate downhole friction, but we should be able to design around it, once better understood

• Gathering real-world data is a first & significant step

“to measure is to know – if you cannot measure it, you cannot improve it”
– Lord Kelvin
Next Steps

• Join ALRDC and help direct this project
• You can help:
  – Develop the test program to be carried out by the project operations group
  – Generate tool & data specifications to be implemented by the operations group
  – Provide resources and funding
  – Identify & allow access to test wells
  – Participate in testing
  – Get early access to info and tools
Let us know if you can help…

- At the start of the break (in this room)
- At any of our booths:
  - Weatherford, Echometer, Black Gold
- Via email:
  - Victoria.pons@weatherford.com
- Or if you know someone who might be interested in helping…
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