Horizontal Well Downhole Dynamometer Data Acquisition: Update

Project sponsored by ALRDC

Chair: Victoria Pons, Ph.D.
Walter Phillips
Cleon Dunham
Norm Hein
Bill Lane
Tony Podio, Ph.D.
Lynn Rowlan

(((ECHOMETER)))

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Project Goal & Overview

- Gather true measured data on both deviated & 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
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

A “legible” pumpcard usually indicates good inputs and methods

Wellbore friction and fluid dynamics are not accounted for
How Will Measuring Well Dynamics 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

"Assume No Friction!!!"

Gather True Downhole Measurements → Compare Against Calculated Data → Update & Improve Model

Critical Validation Step

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
• **ALRDC will provide seed money for initial stage of tool design & development**
  – Design expertise & development resources are welcome

• **Tools placed along the rod string, stores data on-board**
  – Location and number of tools to be determined
    • Approximately 6-8 tools per well
  – Tools will be placed at key location on the rod string to capture:
    • Rodstring dynamics caused/influenced by side-loading
    • Mechanical friction due to deviated portions of the wellbore
    • Pump friction
Downhole Dynamometer Tool

Tool Sensors

- Axial/Bending Load
  - Strain Gauges
- Stroke Position
  - 3-Axis Accelerometer
- Pressure (PSI)
- Temperature
- Additional Channels
  - For further expansion

• Non-volatile flash storage
• Time synchronized acquisition
• ~30 days worth of storage/battery
A bit more detail – Test Wells

- All distinct categories of deviated wells
  - Vertical (for control test), Slant, “S”, and Horizontal

- Testing Criteria
  - Test at different SPM – slow & fast pumping speeds
    - At low speeds, mechanical friction forces should be more evident
  - Anchored vs. unanchored tubing
  - Rod guides vs. no rod guides (varying rod guides placement)
  - Rod string configuration (steel, fiberglass, sinker bars)
  - Depth of kick off point
  - Fluid properties
    - Viscosity, gas, etc.
Artificial Lift Research and Development Council (ALRDC)

The ALRDC is an International, Private, Not for Profit organization. There are currently about 2,900 members. Among its functions are:

• Sponsoring International Workshops and Conferences on Sucker Rod Pumping, Gas Well Deliquification, and Gas-Lift
• Helping with other Workshops and Conferences on Electrical Submersible Pumping and Progressing Cavity Pumping
• Helping to sponsor important Artificial Lift R&D projects such as this Horizontal Well Downhole Dynamometer Data Acquisition project
• Maintaining a Technical Library of Artificial Lift reports, articles, etc.
• Providing Scholarships for Students of Artificial Lift at several major Universities

2016 Gas Well Deliquification Workshop
Denver, Colorado
Responsibilities:

• Manage the overall project

• Select and approve the members of each of the sub-committees

• Hold Committee meetings as needed to track the overall project

• Report on the status of the overall project to the ALRDC R&D Committee

• Report on the status of the project at appropriate ALRDC-sponsored Workshops
Business Sub-Committee

Responsibilities:

• Define the technical details of the project
• Define the budget for the project
• Solicit funding for the project
• Manage the finances of the project
• Document the project as it unfolds
• Ensure access to the data once it has been collected, analyzed, and stored
• Determine lease or purchase of the downhole tools – post testing
Responsibilities:

- Select the tool design/manufacturing company
- Design & build the tool
- Test the tool in the lab
- Test it in a vertical well
- Modify the design as needed based on the initial tests
- Test it in a deviated well
- Test it in a horizontal well
- Make final modifications to the design, as needed
Responsibilities:

• Outline testing procedures and well selection criteria
• Select Operating Companies to deploy the tool
• Work with the Operating Company to choose the test wells and design the tool deployment procedures
• Select & work with a Service Company to gather surface dynamometer data during the tests
• Work with the Operating Company to acquire data from the tools when they are pulled
Data Validation
Sub-Committee

Responsibilities:

• Select a Company to validate the data, build a database, and maintain the data

• Work with a Company to validate the collected data

• Work with them to place the data in a database from which the Industry can retrieve the data

• Work with them to develop a database maintenance protocol

• This project will generate a lot of data
ALRDC will provide resources to get this project started

RFQ For Tool Manufacturing

Build & Lab Test Prototype Tools

Build Tools

Deploy Tools, Record Data

Significant Well & Facilities Resources

Industry financial & management support needed
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
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
Advantages of joining HWDDDA

• Help guide the project
• Access to the measurement tools after initial data collection is completed
• Early access to data:
  – Surface position and load
  – Standing valve test and Traveling valve test
  – Axial and Lateral loads
  – Continuous gyro surveys
  – High resolution deviation surveys
Next Steps

• Join one or more sub-committee(s) and help direct this project

• You can help:
  – Develop testing procedures
  – Participate in 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 data and tools
Let us know if you can help…

- Sign up with Lynn Rowlan at the Echometer booth or with Walter Phillips at the Black Gold booth
- Via email, contact Victoria Pons:
  - Victoria.pons@weatherford.com
- Or if you know someone who might be interested in helping…
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