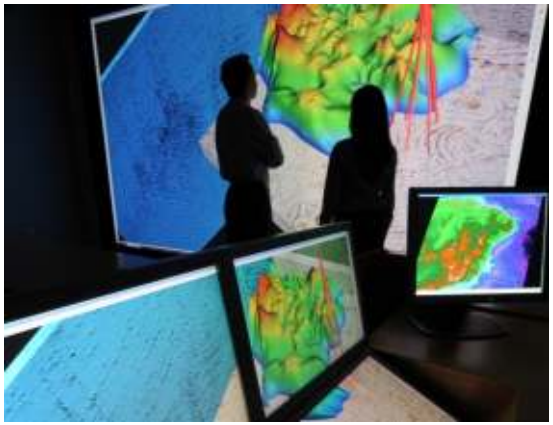
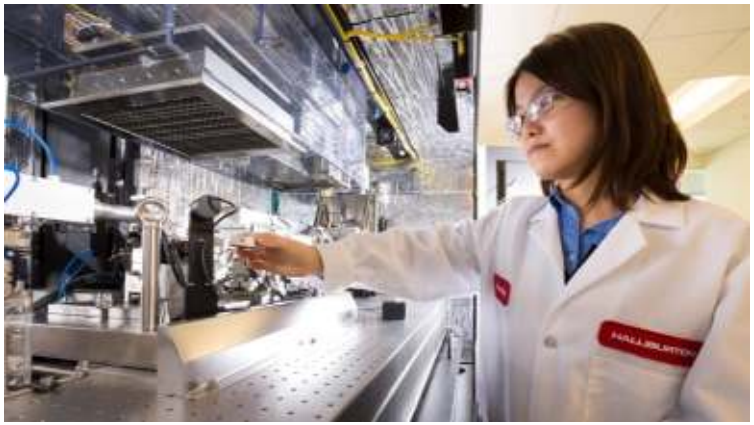



SLAP 2016
SIMPOSIO LATINOAMERICANO DE PERFORATING

Engineered Perforating Design for Hydraulic Fracture Stimulation

SLAP 16-19

Martin Schoener Scott, Halliburton

HALLIBURTON

INTRODUCTION

- Minimizing costs while maximizing the profitability of pumpdown plug and perforating.
  - Analyzing consistent hole charge (CHC) attributes (rate and pressure) reveals the true value.

INTRODUCTION

OBJECTIVES

- Evaluate three charge designs and there effects on **fluid volumes, rates, and proppant placement amounts.**
- All charges must be industry standard technology

CHALLENGES

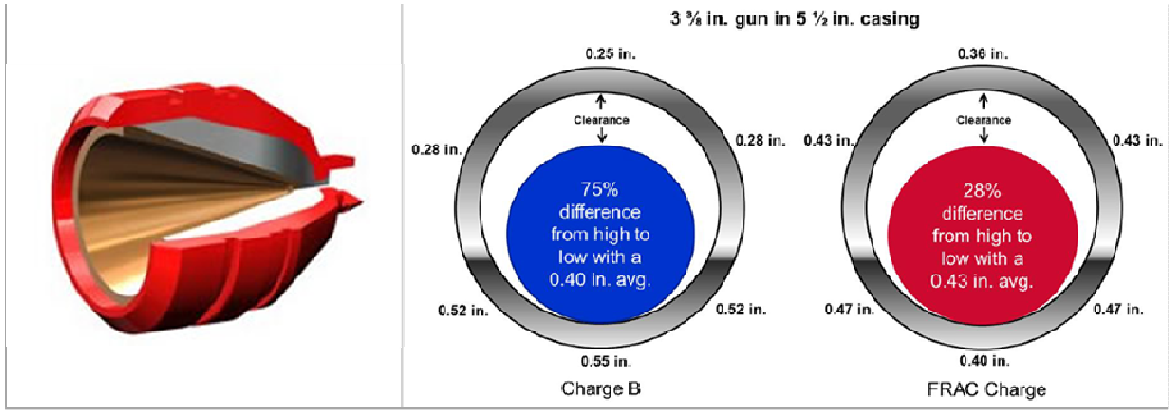
- Located well data that used multiple charge designs in one well for the closest charge to charge comparison.
- Quantify the charge effects and the monetary gains

Charge Methodology

- Deep Penetrating charges focus on greatest penetration depth with little regard for hole size variances
- Good Hole charges achieve the larger average EHD only when gun is eccentered (reduce gun to casing clearance)
- Constant Hole Charges is designed for reduced EHD variance while balancing perforation depth for unconventional completions

Charge Methodology

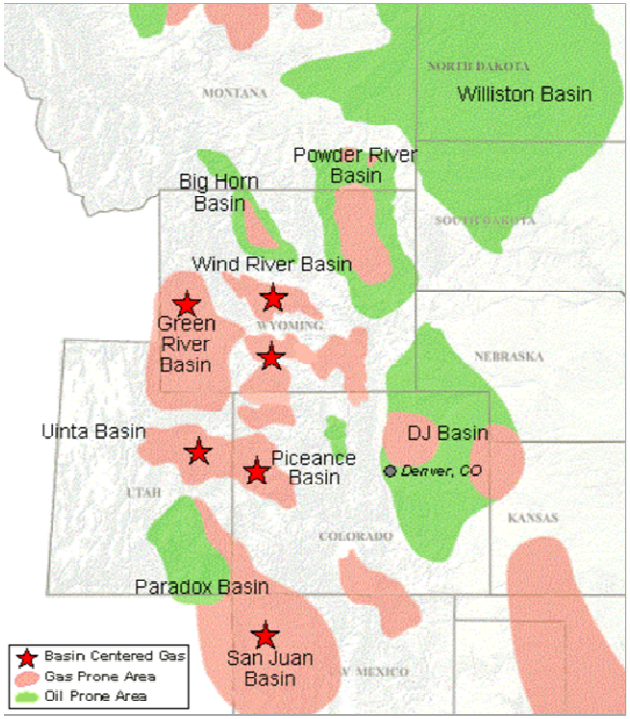
- A significant issues with this type of multistage completion is that the treating pressures are often greater than expected



- Fracture perforating charge or CHC was engineered to minimize the perforation coefficient and yield a more consistent entry-hole diameter consequently

Background

- Analyzing the data for “normal” CHC attributes (rate and pressure), these attributes were observed to also affect the fluid volumes, rates, and proppant amounts.



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Case Study

The following lists summarize the findings of the field study.

- A total of 17 wells were shot with CHC.
  - Ten wells were finished that could provide some comparison to SDP charges shot in adjacent stages, wells, or pads.
  - Seven wells not used as a charge comparison.
    - Two wells not used because operator had previously only done only sleeves.
    - Four wells had too many variables changed between the SDP charges and CHC pads.
    - One well was a lone hybrid and had numerous issues/changes on the PE side throughout the completion.

- **Nine of the ten wells used for comparison indicated less fluid used on the CHC stages, as compared to either the same well, non-CHC stages, or prior trends**.

Synergy Two Well Pad: DJ Basin

- A total of 47 stages were shot between the two wells (Table 1).
  - Twelve of the stages were shot with CHC, and 35 were shot with SDP.
  - In one well, a 6% reduction in fluid occurred on the CHC stages in one well, with a 2% reduction in the other. The savings on the 12 stages translated to approximately $6,900 in fluid cost savings.

Synergy Well #1

Stage	Charge
2	Standard DP
3	Standard DP
4	Standard DP
5	Standard DP
6	Standard DP
7	Standard DP
8	Standard DP
9	Standard DP
10	Standard DP
11	Standard DP
12	Standard DP
13	Standard DP
14	Standard DP
15	Standard DP
16	Standard DP
17	Standard DP
18	Standard DP
19	Standard DP
20	Standard DP
21	Standard DP
22	CHC
23	CHC
24	CHC
25	CHC

Synergy Well #2

Stage	Charge
2	CHC
3	CHC
4	CHC
5	CHC
6	CHC
7	CHC
8	Standard DP
9	Standard DP
10	Standard DP
11	Standard DP
12	Standard DP
13	Standard DP
14	Standard DP
15	Standard DP
16	Standard DP
17	Standard DP
18	Standard DP
19	Standard DP
20	Standard DP
21	CHC
22	CHC

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Synergy Two Well Zipper: DJ Basin

- The first seven stages in each well were compared:
  - The wells were located in the same formation.
  - 29% less fluid used in the CHC toe stages than the SPD stages, but the same amount of proppant (within 500 lb) was placed.

- Note: Different fluid systems used on each well:
  - Union 12-5CHZ used a slickwater completion.
  - Union C-5CHZ used a PermStim™ completion.

Two Single Wells – DJ Basin

- Two wells were shot completely with CHC charges, as compared to three previous wells shot completely with SDP.
  - Only one well used for comparison.
  - The second well had numerous completion fluid/design changes mid-job and was a hybrid, unlike the rest.
- 12% less fluid used in the CHC well, as compared to the average of the previous three wells.
- 16% more proppant was placed in the CHC well.

Single Well Multiple Charge Types (CHC REACTIVE LINER (RL) SDP) – Powder River Basin

- High pressures and low rates occurred on the first nine stages; the operator decided to experiment (Table 2).
  - Overall: 14 SDP stages, 11 RL stages, 6 CHC stages.
  - Total fluid pumped was decreased by less than 1% decrease on the CHC stages, as compared to the others, but 12% more proppant was pumped.
  - Assuming that the goal is to place 100% of the designed solids, the CHC stages used 12% less fluid per pound of proppant.
- Based on field ticket costs for fluids:
  - CHC stages reduced the total fluid costs by 4%.
  - An additional 7% of total fluid costs could have been saved

Stage	Charge
2	SDP
3	SDP
4	SDP
5	SDP
6	SDP
7	SDP
8	SDP
9	SDP
10	RL
11	RL
12	RL
13	RL
14	RL
15	RL
16	RL
17	RL
18	RL
19	CHC
20	RL
21	CHC
22	CHC
23	CHC
24	SDP
25	SDP
26	SDP
27	SDP
28	RL
29	CHC
30	CHC
31	SDP
32	SDP

Additional Trials

- Single well (Powder River basin): 6% less fluid was pumped per pound of proppant.
- 4 CHC wells vs. 5 SDP wells (Bakken): 7% less fluid was pumped per pound of proppant.
- Single well (Powder River basin): 8% more fluid pumped per pound of proppant on CHC stages

CONCLUSIONS

Although the percentages appear to be small, the use of CHC has a positive long-term effect on the maintenance requirements and efficiencies of the frac crew. In addition, less fluid required reduces the costs for the operator.

Acknowledgements / Thank You / Questions

We would like to thank AAPG for allowing us the opportunity to present a new way to understand value of the right Perforating Technology .

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QUESTIONS? THANK YOU!