

Advancing Reservoir Performance

StimGun™ and StimTube™ Tool Successes in West Texas

4/26/2013





4/26/2013

Propellant Tool Components



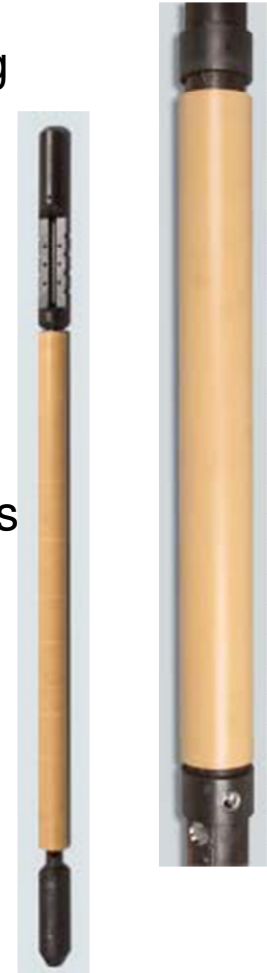
- Cast potassium perchlorate sleeve slid over the perforating gun.
- StimGun™ sleeves available for most gun systems from 2.00" OD through 7.00" OD



- The sleeve is fragile and requires protection.
- Centralized tandems prevent the sleeve from contacting the casing wall.
- Retainer collars keep the sleeves in place on the perforating gun.

Propellant Assisted Perforating

- Propellant tools are made up of Potassium Perchlorate and a bonding resin
- It is an oxidizer , safe for storage and transport
- Product requires containment to initiate proper burn sequence
 - A lazy yellow flame is produced when ignited in open air
- When confined, Propellant burns and creates high pressure gas waves that propagate micro fractures extending past the perforation tunnel
- These high pressure gas waves follow the explosive train and thus remain perpendicular to the well bore
 - This “Dynamic” event exceeds fracture pressure of the formation but does not crush the formation rock
 - Gas waves break away the perforation crush zone and carry the debris past the perforation tunnel
 - Provides connectivity to fresh formation rock
- Fractures are created past the damage caused by the drilling process which equates to lower skins



The Grayburg Formation

- A carbonate reservoir, 1 to 5 mD permeability
- 10-15% porosity
- 1,200 to 1,500 psi reservoir pressure
- .75 psi/ ft. fracture gradient.

4/26/2013

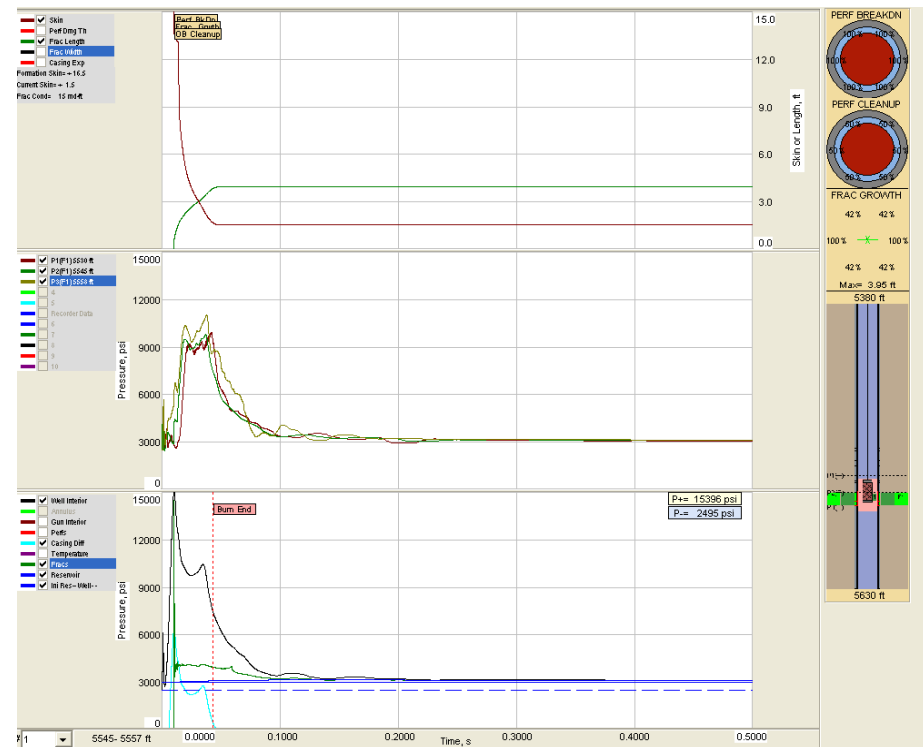
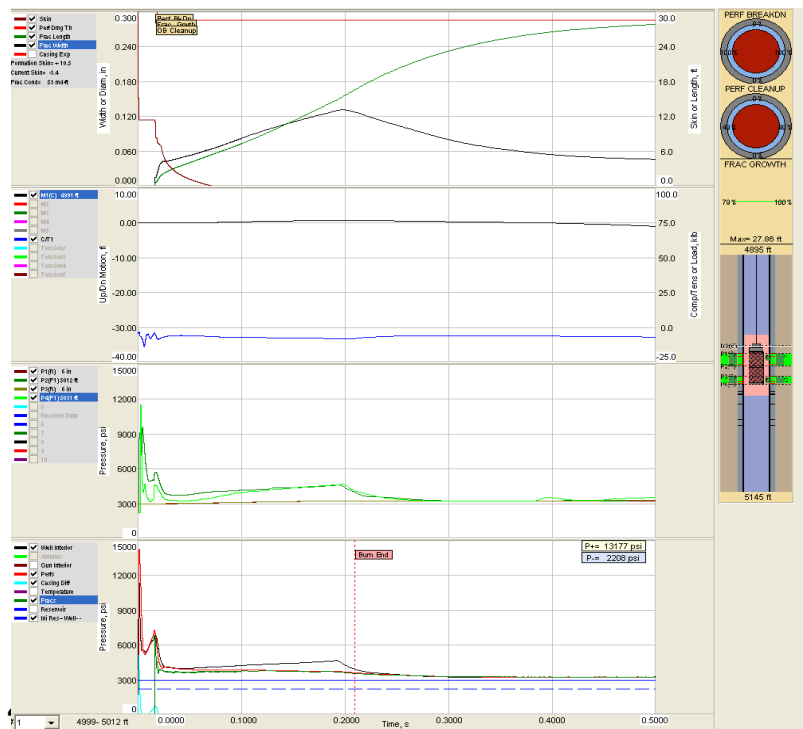
Client Problem

- Barium Sulphate scaling had severely reduced injectivity in majority of their waterflood wells.
- The scaling collected in and around the perforation tunnels in both injectors and producers.
- Typical Workovers required coiled tubing with chemical washing to restore injectivity or sufficient inflow for pumps.
- On water producers, cavitation and cycling of the pumps were constant problems due to chronic low fluid levels.
- StimGun and StimTube were recommended as potential money and time saving enhancement tools for the client.

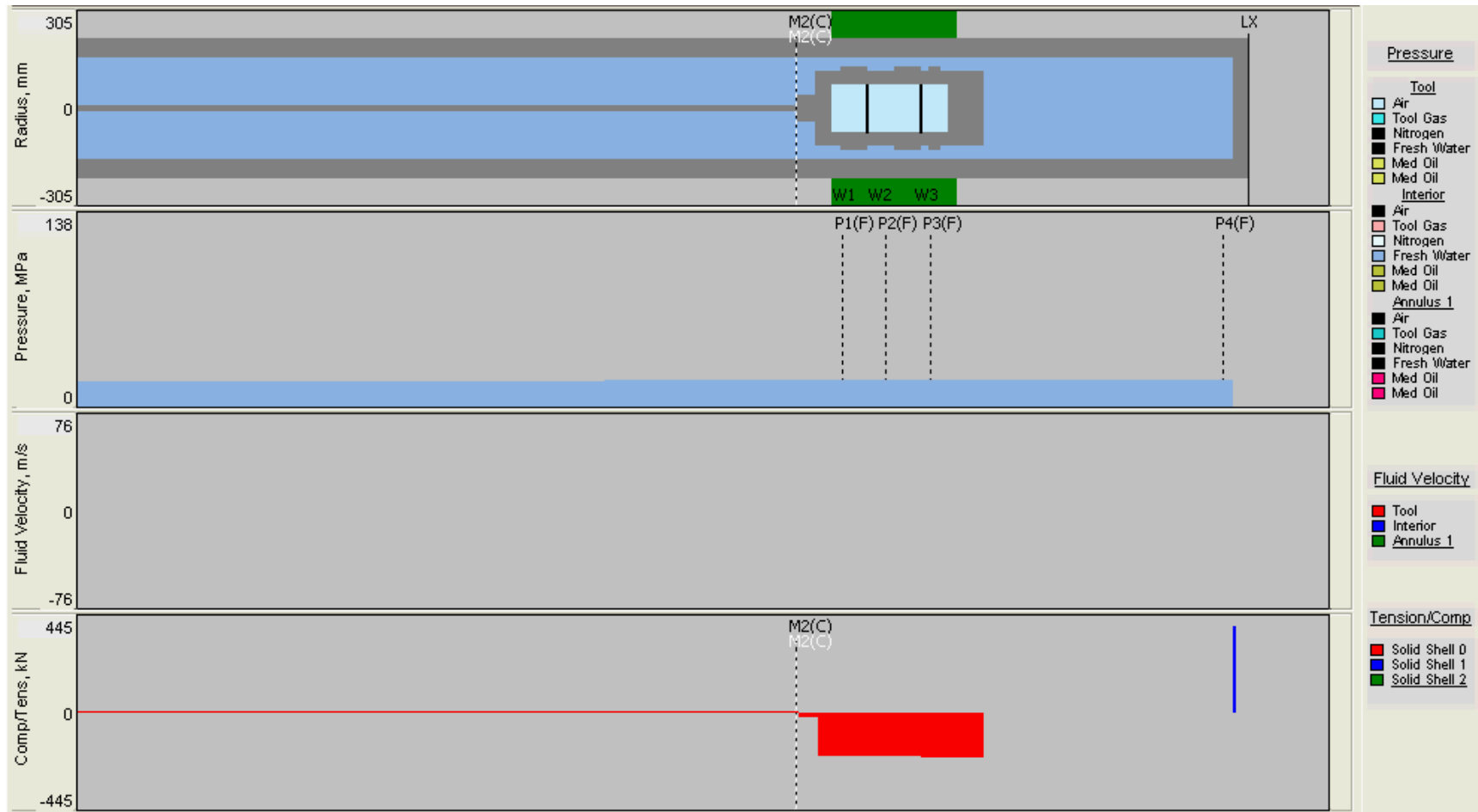
4/26/2013

Modeling

- Each well used PulsFrac™ modeling software to predict the success of the job and to highlight any potential problems that might occur when using high energy propellants.

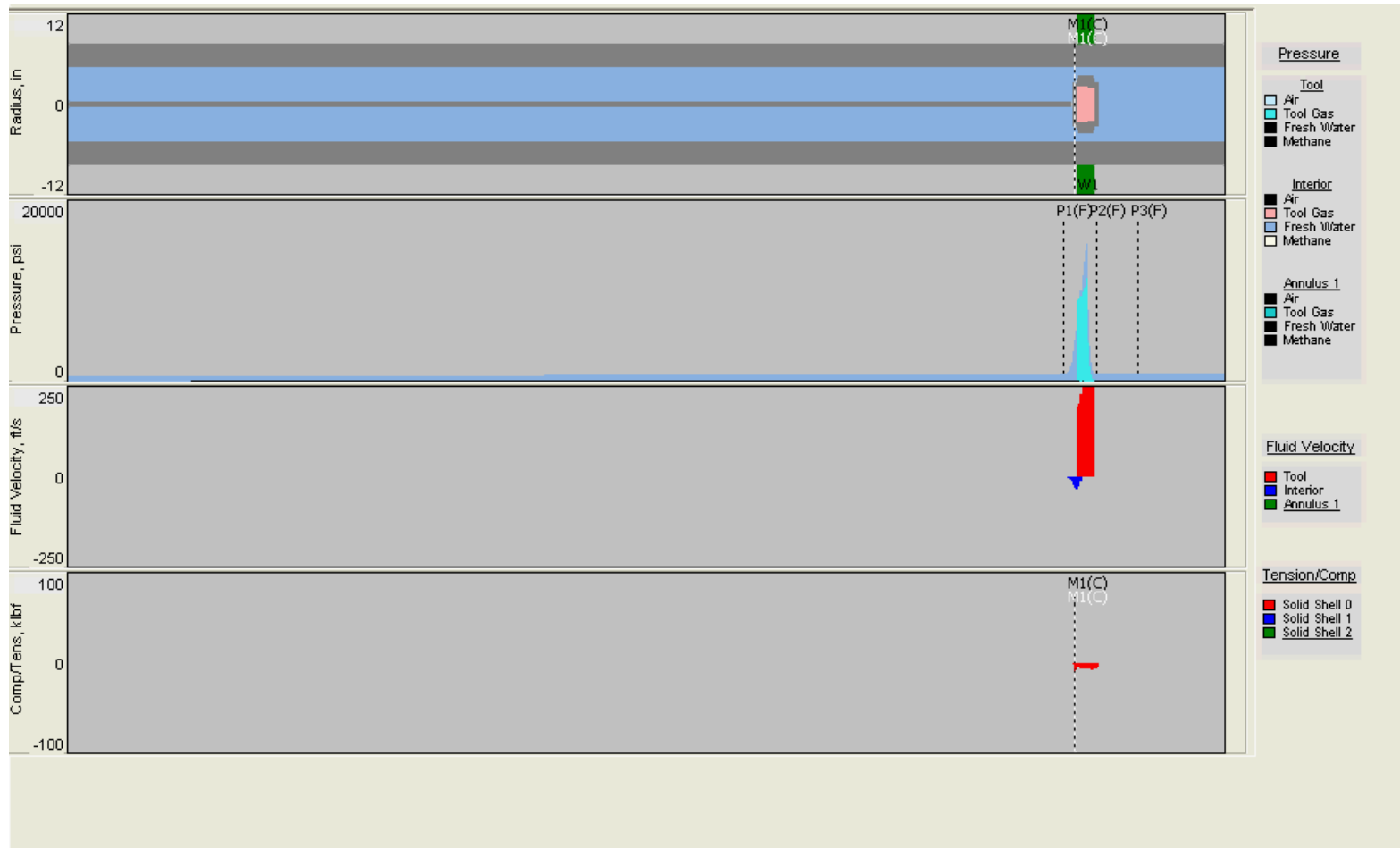


Modeling Can Help us



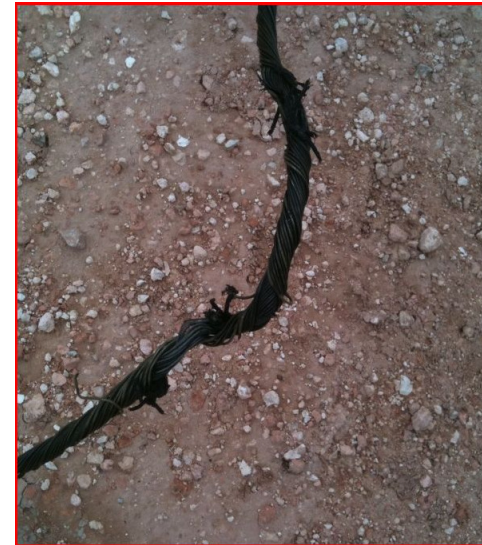
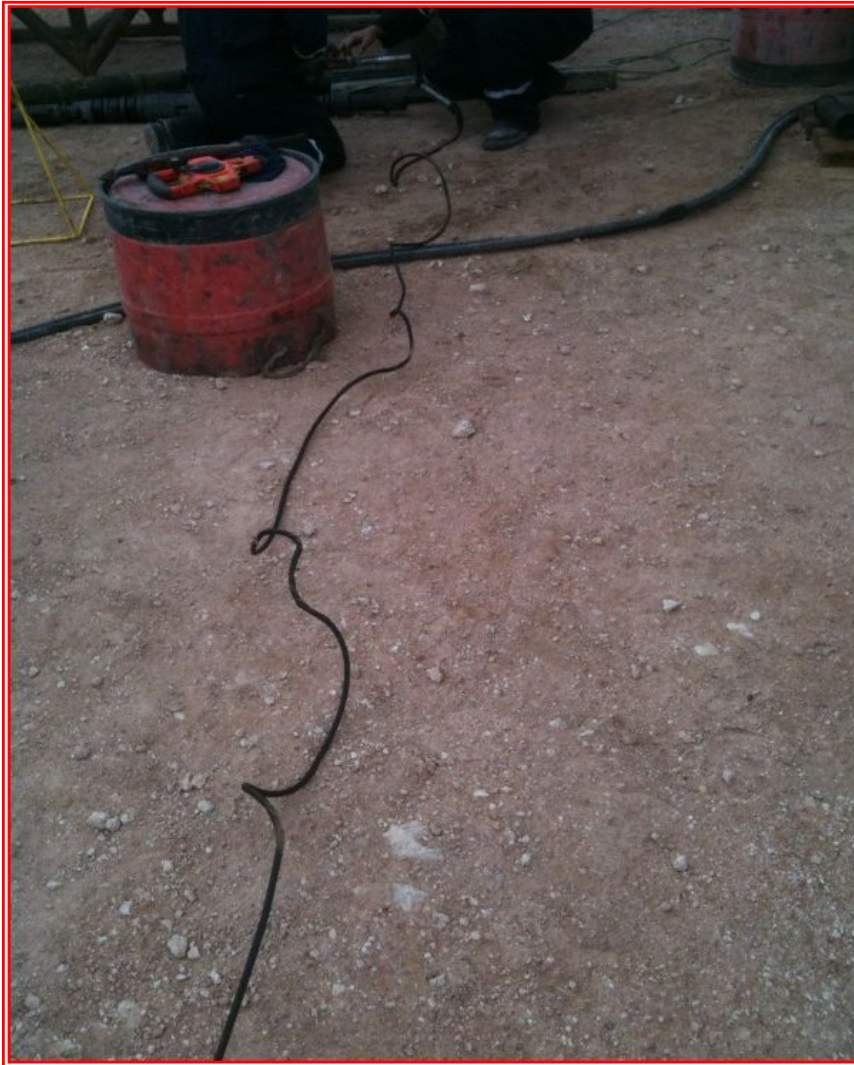
4/26/2013

You Can See Trouble Coming (Sometimes)



4/26/2013

It was not all roses.



- Several tools were lost.
- On occasion the wireline was damaged when the tools were shot up the hole.

4/26/2013

Results

- To date more than 350 wells have been treated in the West Texas New Mexico basin for various clients.
- More than 95% of the wells have responded favourably to propellant stimulation.



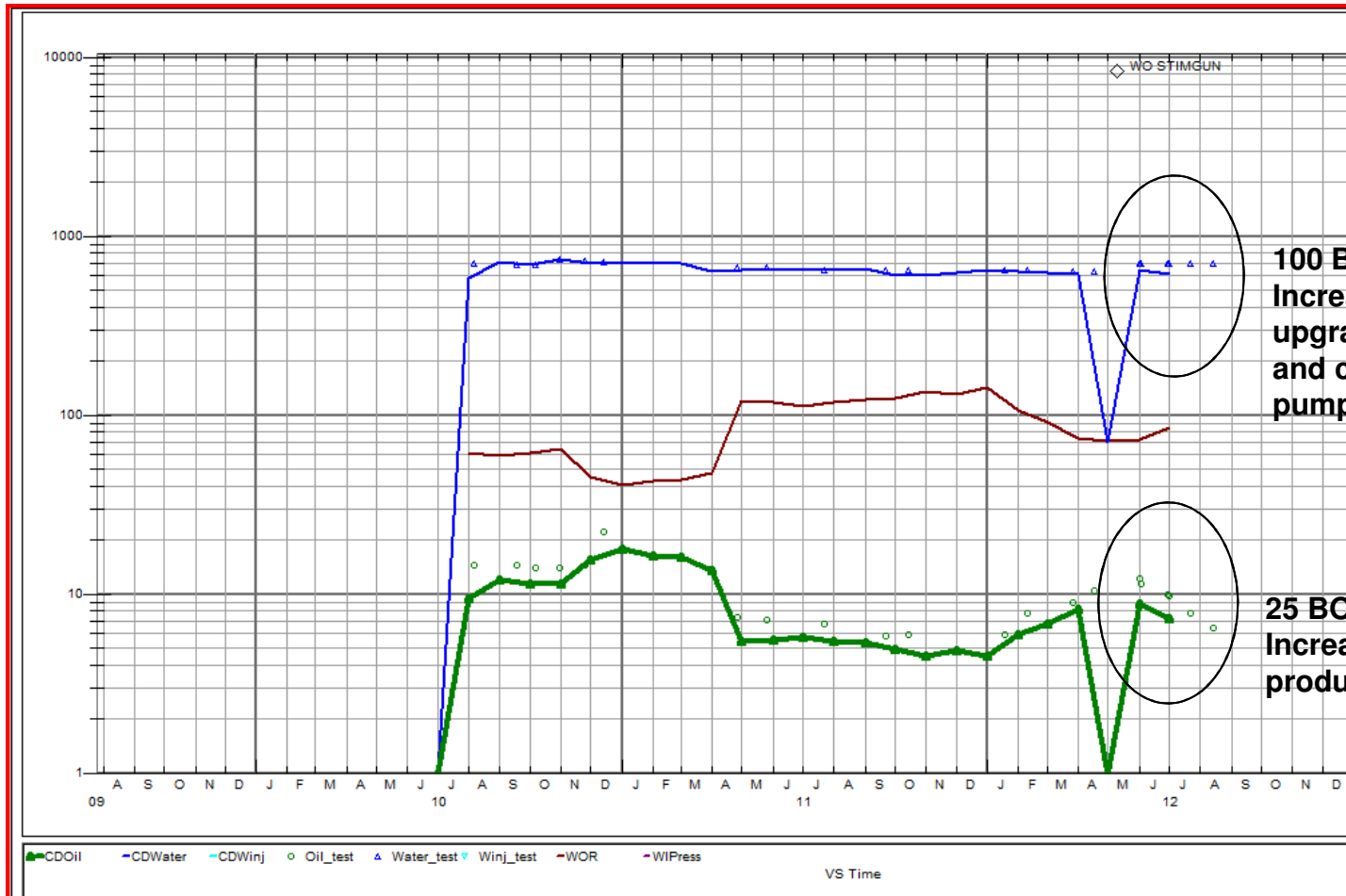
4/26/2013

Case Histories

- CVO Eunice King 14
 - Well completed without acid treatment, but with a similar injection profile to offset wells.
 - Client saved **\$220,000.00** on this well by eliminating acid and related costs.
 - 14 additional wells completed with similar results, totals savings to the client: **\$3,080,000.00**
- CVO Lockhart #8
 - The initial test was very positive with significantly with lower pressures for flow rates
 - However the well was not put on production for more than seven months and has not performed as well as it tested.
 - Flow rates are still better than offset wells that had been acidized.
 - Savings of **\$200,000.00** in acid and rig time.

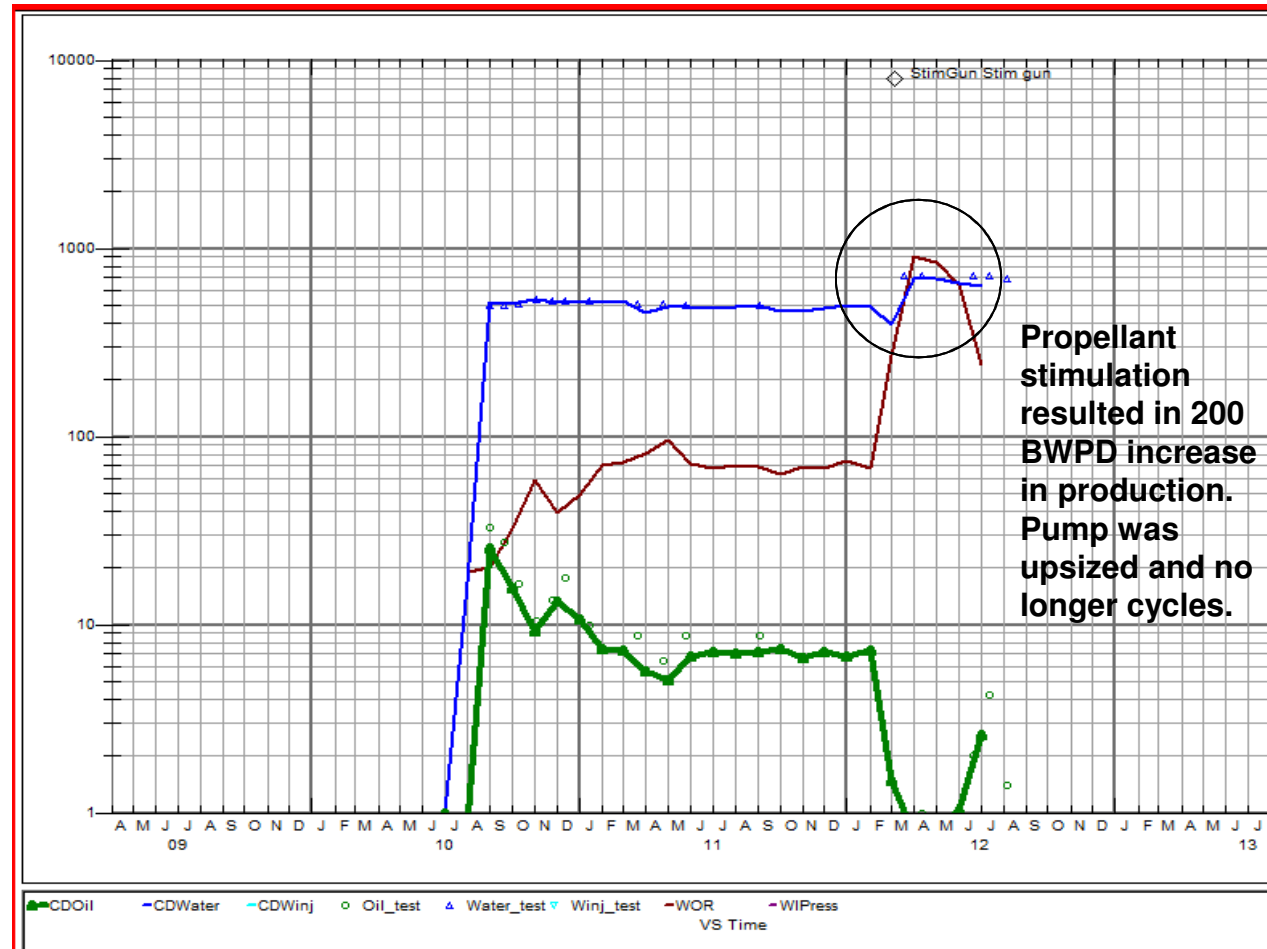
4/26/2013

Water Producer



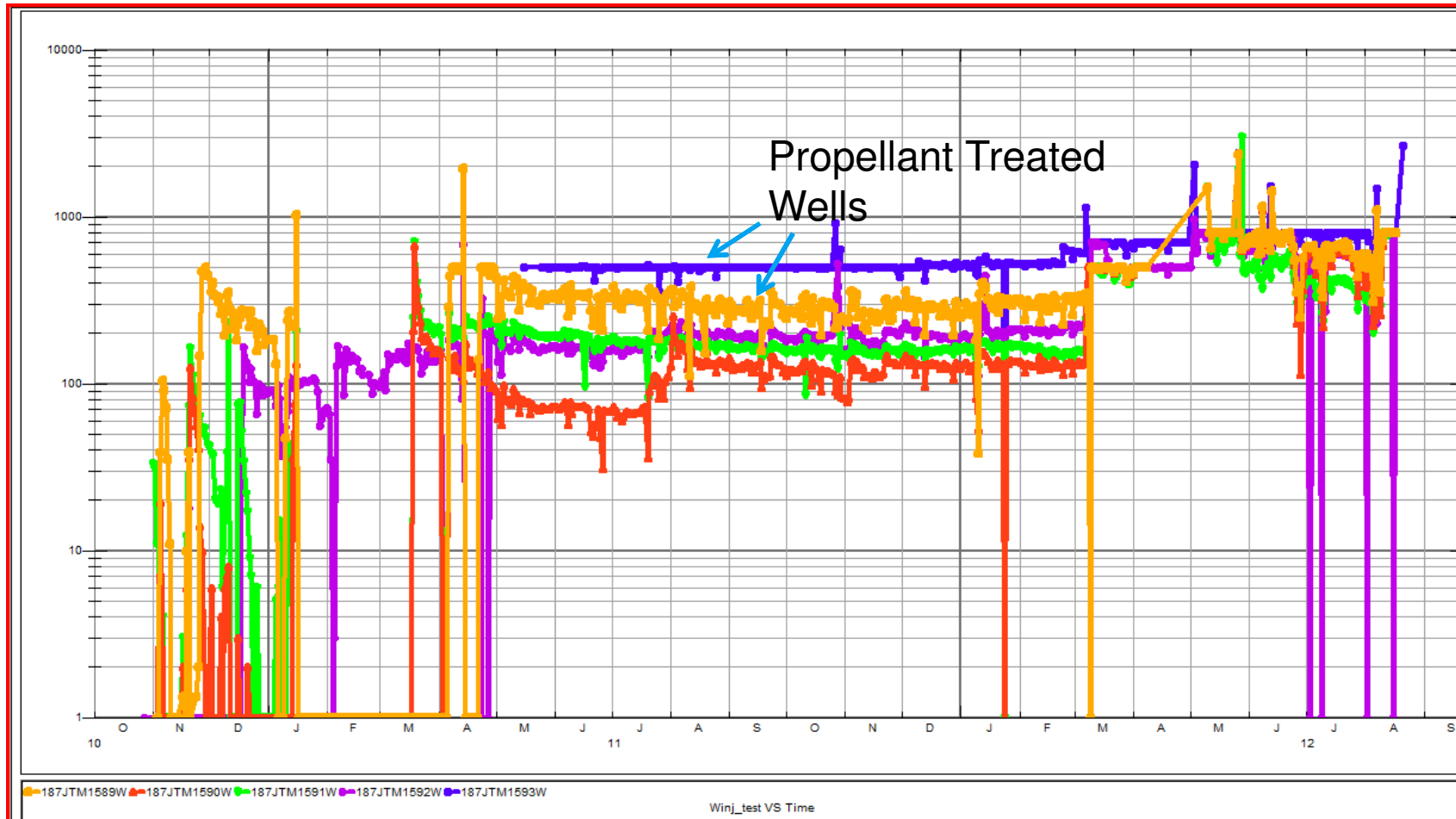
4/26/2013

Water Producer



4/26/2013

Water Injectors



4/26/2013

Using StimTube to overcome Barium Sulphate Scaling in Oil Producer

- CVO Sims A #6
 - This well treated with a StimTube tool.
 - Significant problems with Barium Sulfate Scale
 - Working with in house Chemists, additives along with a slicking agent used treat scale were placed across the perforations with a bailer.
 - The propellant was used to inject the chemicals and to further clean and break down the perforations.
 - Large quantities of scale were recovered with a bailer.
 - The well doubled production by over 200 bbls/day for six months



4/26/2013

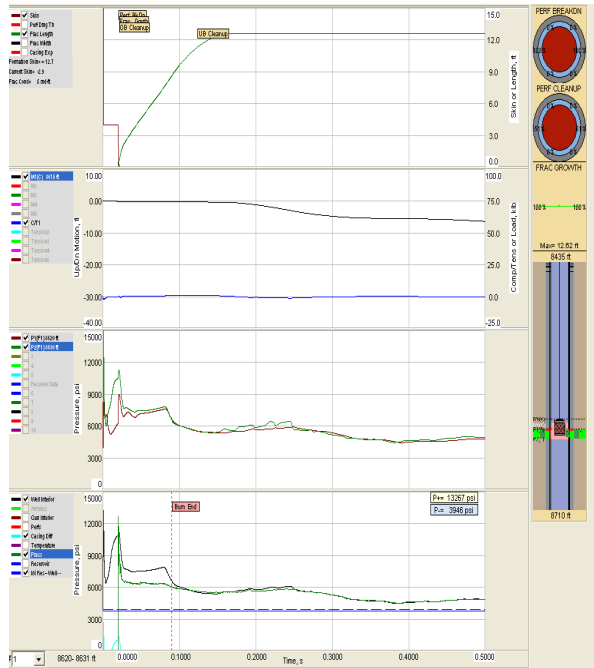
Propellant Rejuvenates North Dakota Producer

- South Pine 24X 15A
 - Production had dropped to 102 BOPD from 280 BOPD
 - Client looking for alternate solutions due to remoteness of location
 - Recommended Propellant Re Perforation

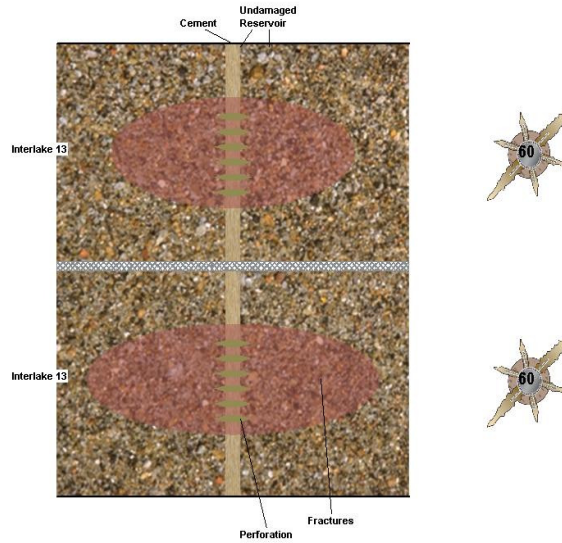
Intervals	Propellant Load	Estimated Peak pressure	Estimated fracture length	Assumed skin Before	Estimated Skin After
8331-8335	100% 4 feet	13,012	9.95	+12.7	-2.9
8341-8345	100% 4 feet	13,174	12.02	+12.7	-2.7
8363-8367	100% 4 feet	14,476		+12.7	
8369-8373	100% 4 feet	13,213		+12.7	
8434-8437	100% 3 feet	12,249	10.33	+12.7	-2.7
8439-8447	100% 7 feet	14,668	14.19	+12.7	-3.1
8620-8631	90% 9 feet	13,267	12.62	+12.7	-2.5

4/26/2013

Propellant Rejuvenates North Dakota Producer

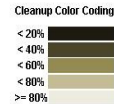


Propellant Stimulation Summary Report



Propellant Stimulation Result

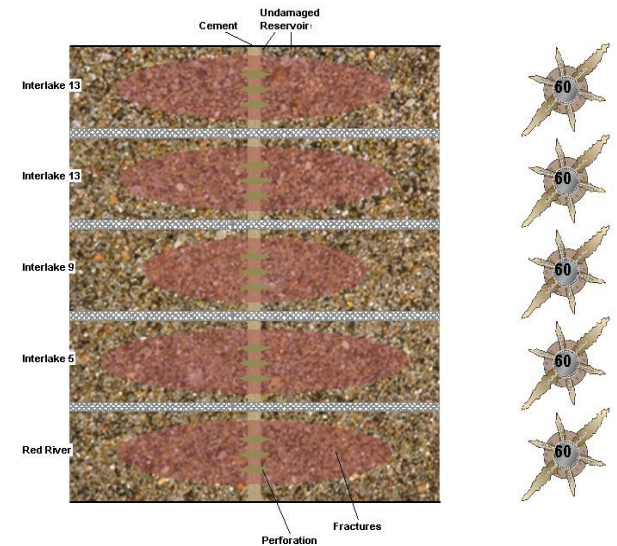
Data	Units	Interlake 13	Interlake 13
Peak Pressure	psi / Mpa	13012	13174
Min Pressure	psi / Mpa	3817	3817
Perf Breakdown	%	100	100
Frac Length	ft / m	9.85	12.02
Perf Cleanup	%	50	53
Skin Before	-	12.7	12.7
Skin After	-	-2.9	-2.7



Note 1: The scaled diagrams illustrate the performance improvement by a combined propellant assisted perforating technique compared to the perforating option only.
 Note 2: Some of the data are output result from PulseFrac™, a product of Baker Hughes Inc.
 As the data in this report reflects calculations and interpretations based on inferences from measurements of various devices, Baker Hughes makes no warranties, express or implied, or guarantees of any kind with respect to the data. Customer agrees that Baker Atlas shall not be liable for any losses, costs, damages or expenses of any nature incurred or sustained by the customer resulting from the use of this data or any decision based thereon.

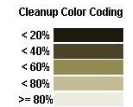
4/26/2013

Propellant Stimulation Summary Report



Propellant Stimulation Result

Data	Units	Interlake 13	Interlake 13	Interlake 9	Interlake 5	Red River
Peak Pressure	psi / Mpa	14470	13213	12240	14088	13267
Min Pressure	psi / Mpa	3827	3830	3856	3862	3946
Perf Breakdown	%	100	100	100	100	100
Frac Length	ft / m	12.53	12.40	10.33	14.19	12.62
Perf Cleanup	%	50	51	50	50	51
Skin Before	-	12.7	12.7	12.7	12.7	12.7
Skin After	-	-2.9	-2.9	-2.7	-3.1	-2.6



Note 1: The scaled diagrams illustrate the performance improvement by a combined propellant assisted perforating technique compared to the perforating option only.
 Note 2: Some of the data are output result from PulseFrac™, a product of Baker Hughes Inc.
 As the data in this report reflects calculations and interpretations based on inferences from measurements of various devices, Baker Hughes makes no warranties, express or implied, or guarantees of any kind with respect to the data. Customer agrees that Baker Atlas shall not be liable for any losses, costs, damages or expenses of any nature incurred or sustained by the customer resulting from the use of this data or any decision based thereon.

Propellant Rejuvenates North Dakota Producer

- Well was put on production at 380 BOPD, production has been sustained for more than 5 months.
- 5 wells in the field have shown similar success.
- Propellants prove to be an excellent method of near wellbore damage removal at significantly reduced cost.

4/26/2013

Conclusion

- Propellants are an effective means of overcoming near wellbore damage and recovering lost production.
- Modeling of the jobs are a critical part of the design process.
- Significant cost savings can be realized in rig time, pumping equipment and acid
- Total savings to the clients in the region is estimated at more than **\$36,000,000.00**

4/26/2013