



Cairo, Egypt, November 7-8, 2022

# MENAPS 2022

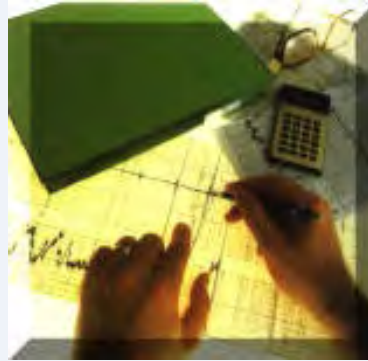
MIDDLE EAST AND NORTH AFRICA PERFORATING SYMPOSIUM

**PERFORATING with**  
**Underbalance "Static and/or Dynamic"**  
**Reactive Charges,**  
**with The Gas Gun,**  
**A Better passage for your oil production**

MENAPS-21-22 AUTHORS: Dominic Wong, Graham Fraser, Tullow Oil, Baker Hughes Rajani Satti, Baker Hughes



Petroleum Development Services PDS



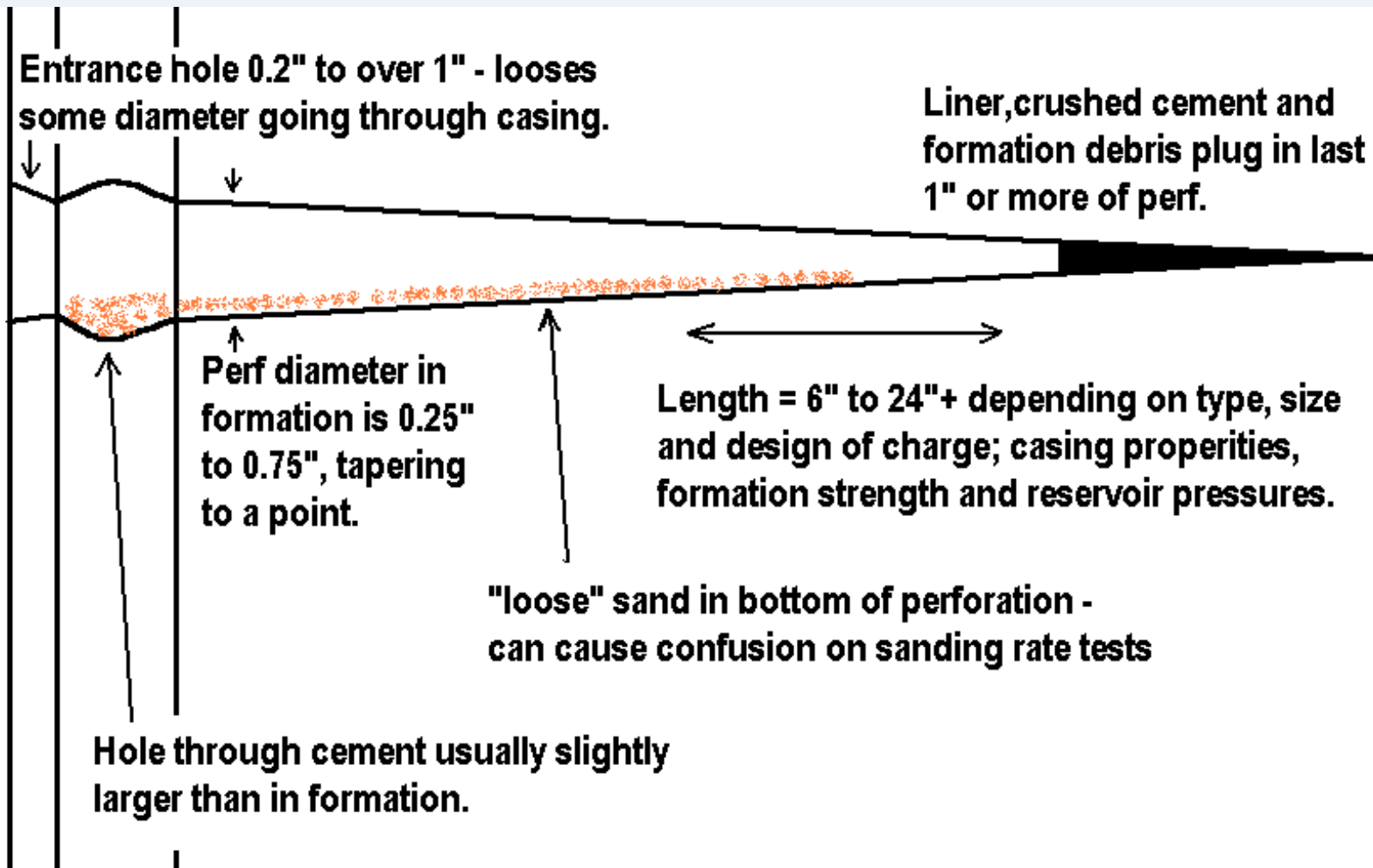


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**A Case Study:** PDS has a case of well located in Red Sea that has a tight reservoir of poor properties. The formation is Nukhul Carbonate with Porosity from 6 - 12 % and Permeability ranges 0.2 - 1 md. randomly. The Reservoir pressure is 1000 psi.

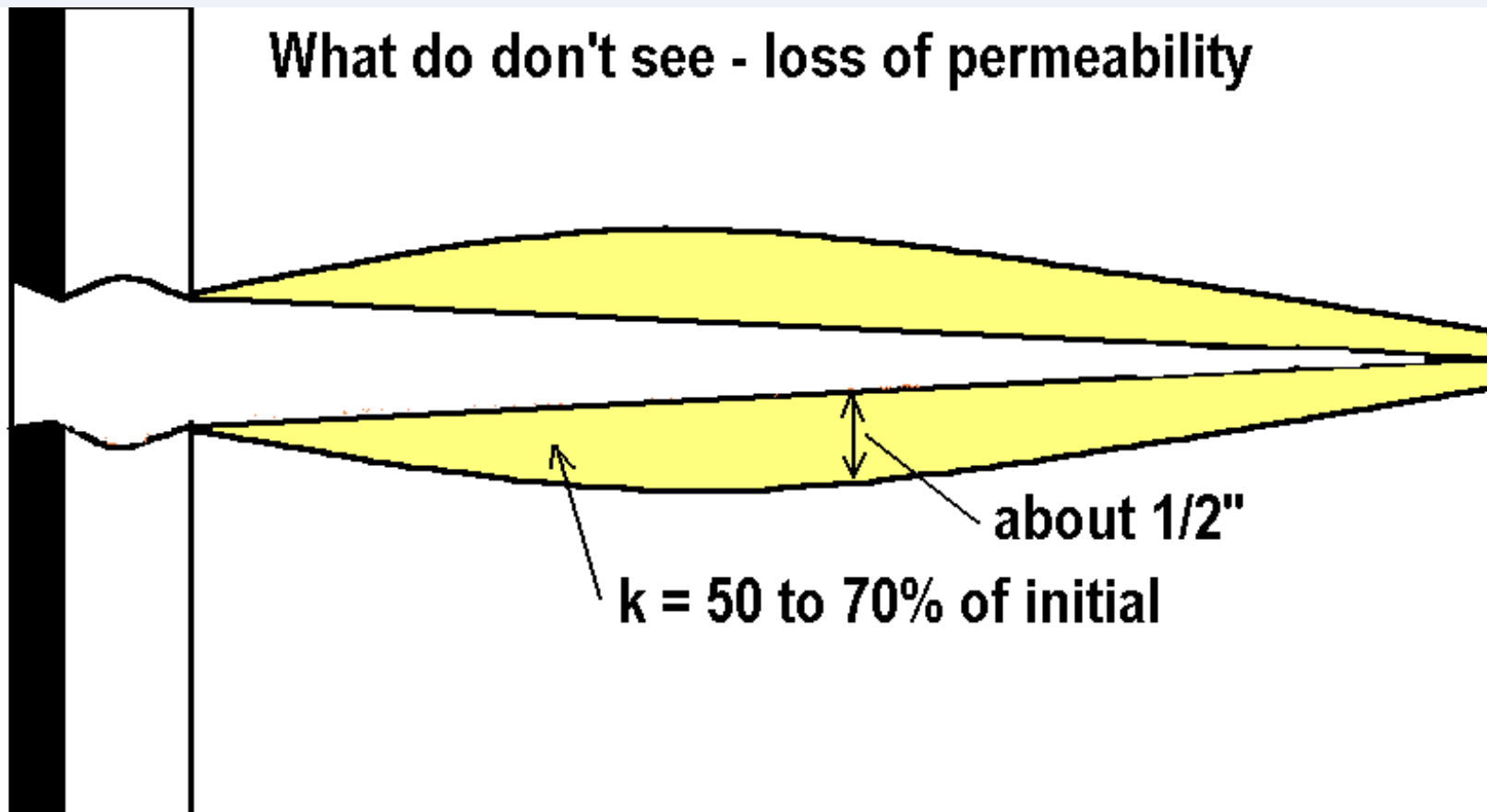


# Anatomy of a Perforation





## What do don't see - loss of permeability



**So, The Target** is to deliver **Long debris-free** tunnels depending on underbalance if achievable. The result will incredibly increase the perforating efficiency, superior productivity, enhanced injectivity, and dramatic improvements in stimulation parameters and performance.

**1. Underbalance "Dynamic or Static".**

**2. Reactive Perforating**

**"Considering debris removal from the perforating Tunnels".**

**1. Gas Gun Fracturing.**

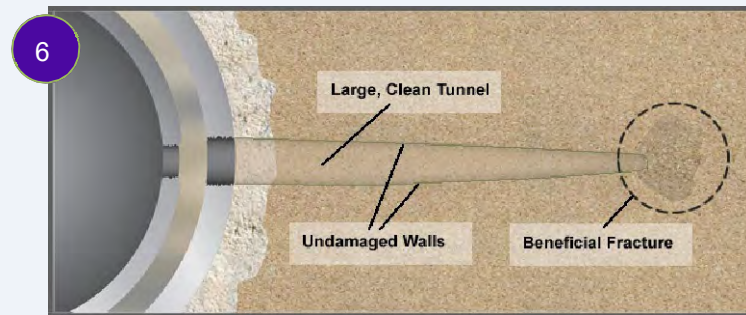
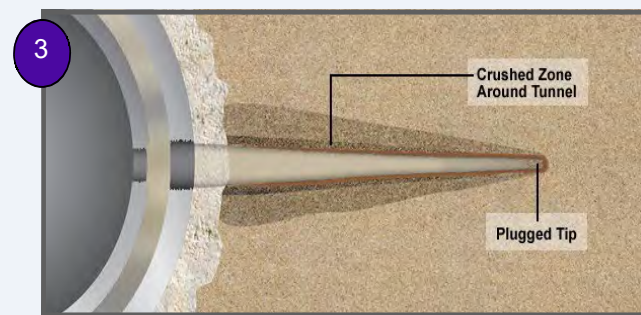
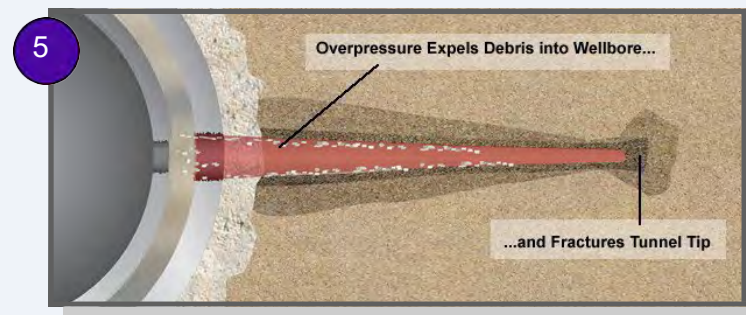
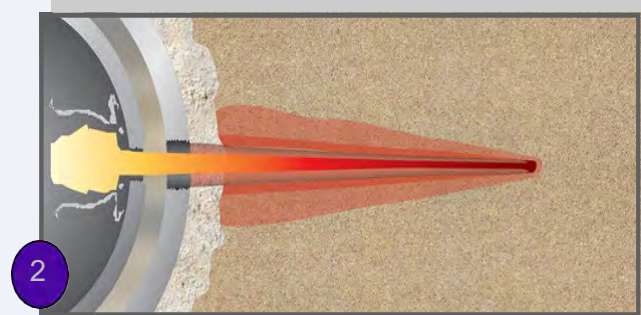
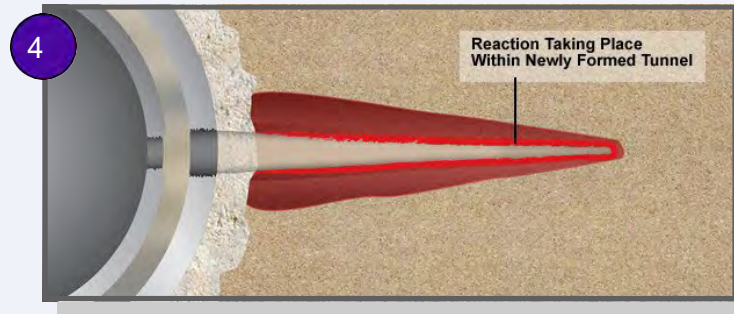
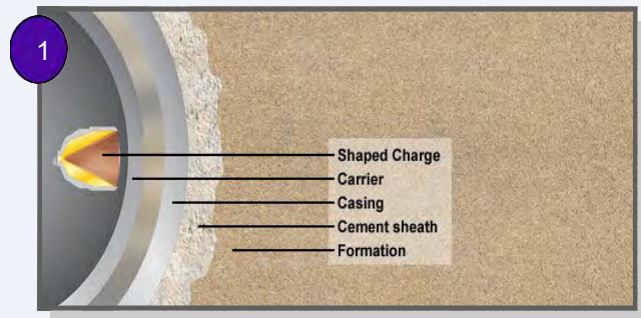
## Castlegate Sandstone

- *Balanced*

*3,500 psi U/B*

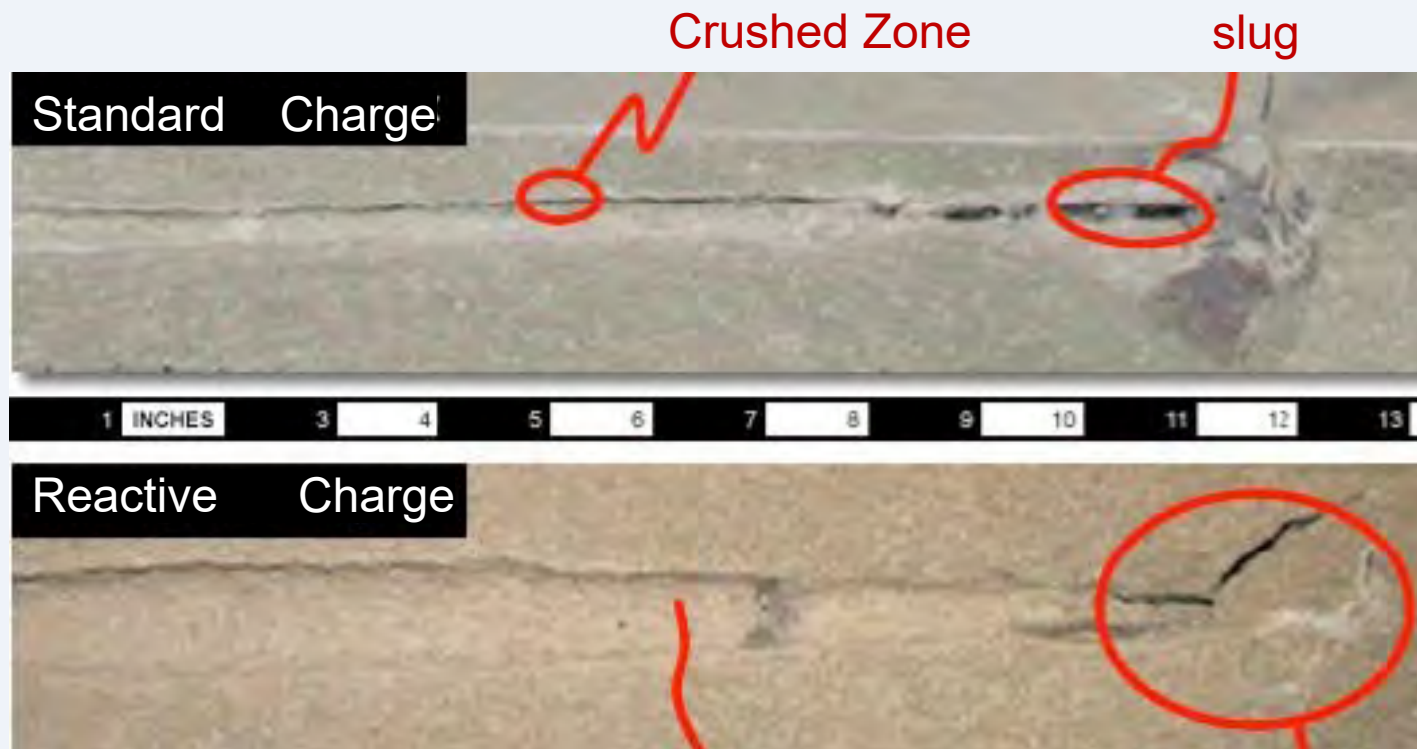


# Reactive Perforating System





PDS is the introducer of the Reactive Perforating System to the Egyptian Oil Industry. The new class of Reactive TM shaped charge that delivers a step change improvement in perforation geometry and performance. The Reactive perforating product generates a secondary reaction in the perforation tunnel thanks to proprietary liner metallurgy and charge design.





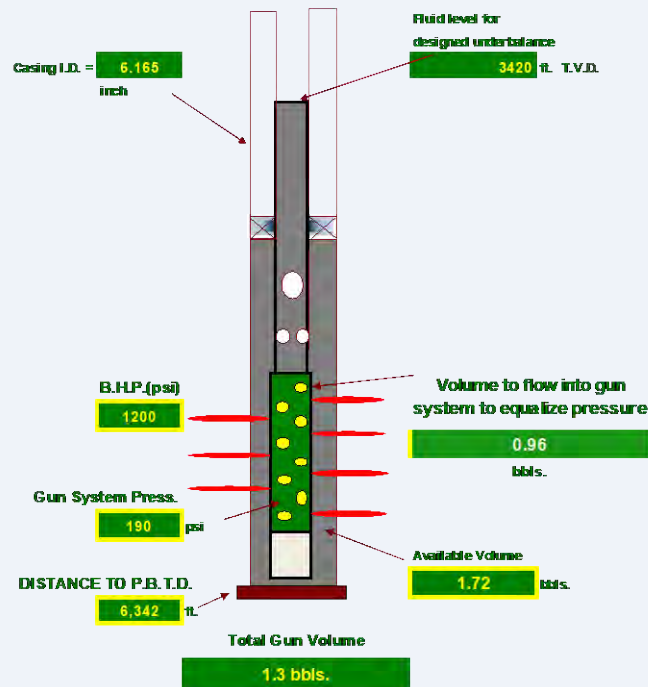
شركة الخدمات لتنمية البترول شركة ذات مسؤولية محدودة بنظام المناطق الحرة

Petroleum Development Services L.L.C. Free Zone

**Input Data**

Well Name =	AZ-1	
Company =	HQ	
Casing I.D. =	6.165	inch
Gun Size (O.D. in) =	4.5	inch
Shot Density =	5	S.P.F.
Charge Wt. =	39	gram
Explosives Type =	H.M.X.	(ex. R.D.X., H.M.X., etc...)
Depth of Penetration =	35	inch
Diameter of Perforation =	0.47	inch
Bottom Hole Temp =	170	°F
length of loaded section =	10.00	FT.
length of Blank section =	90	FT.
Bottom Hole Pressure =	1200	p.s.i
Fluid Weight =	8.3	#/gal
Underbalance =	300	p.s.i
Applied Tubing Gas Pressure =	100	p.s.i
Top Shot @ =	5,505	ft. T.V.D. 4070 ft. M.D.
P.B.T.D. =	6,342	ft. T.V.D. 5217 ft. MD

**Gun System Pressure Calculation Sheet**



**Resulted Data**

Volume Of Perf. ft. =	0.50	Lt./ft.
Volume of Loaded section $V_L$ =	1.825	Lt./ft.
Pressure in loaded Section $P_L$ =	1932	p.s.i
Pressure in loaded Section & Perfs. $P_{LP}$ =	1518	p.s.i
Volume of Loaded section & Perfs. $V_{LP}$ =	2.323	Lt./ft.
Pressure in blank section $P_B$ =	14.7	p.s.i
Total Volume of blank section $V_B$ =	176.0	Lt.
Pressure in all guns, blanks & perfs. $P_{LPB}$ =	190	psi
Volume of all guns, blank & perfs. $V_{LPB}$ =	199.2	Lt.
=	1.3	bbls
Desired annulus pressure to get proper dp. $P_{DA}$ =	800	p.s.i
Volume to be filled in guns to reach $P_{DA}$ $V_{DA}$ =	151.9	Lt.
=	0.96	bbls
Available volume around guns =	1.72	bbls

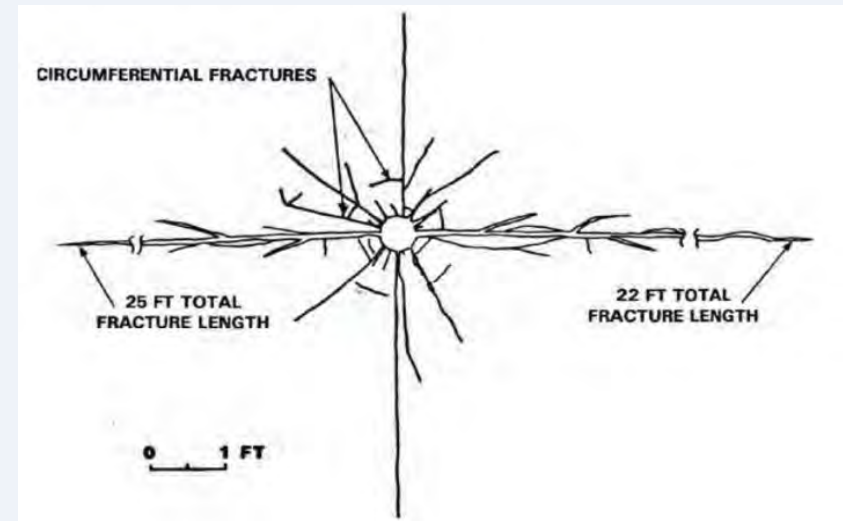
Summary :-

In gratitude to Mr. Edd Colle

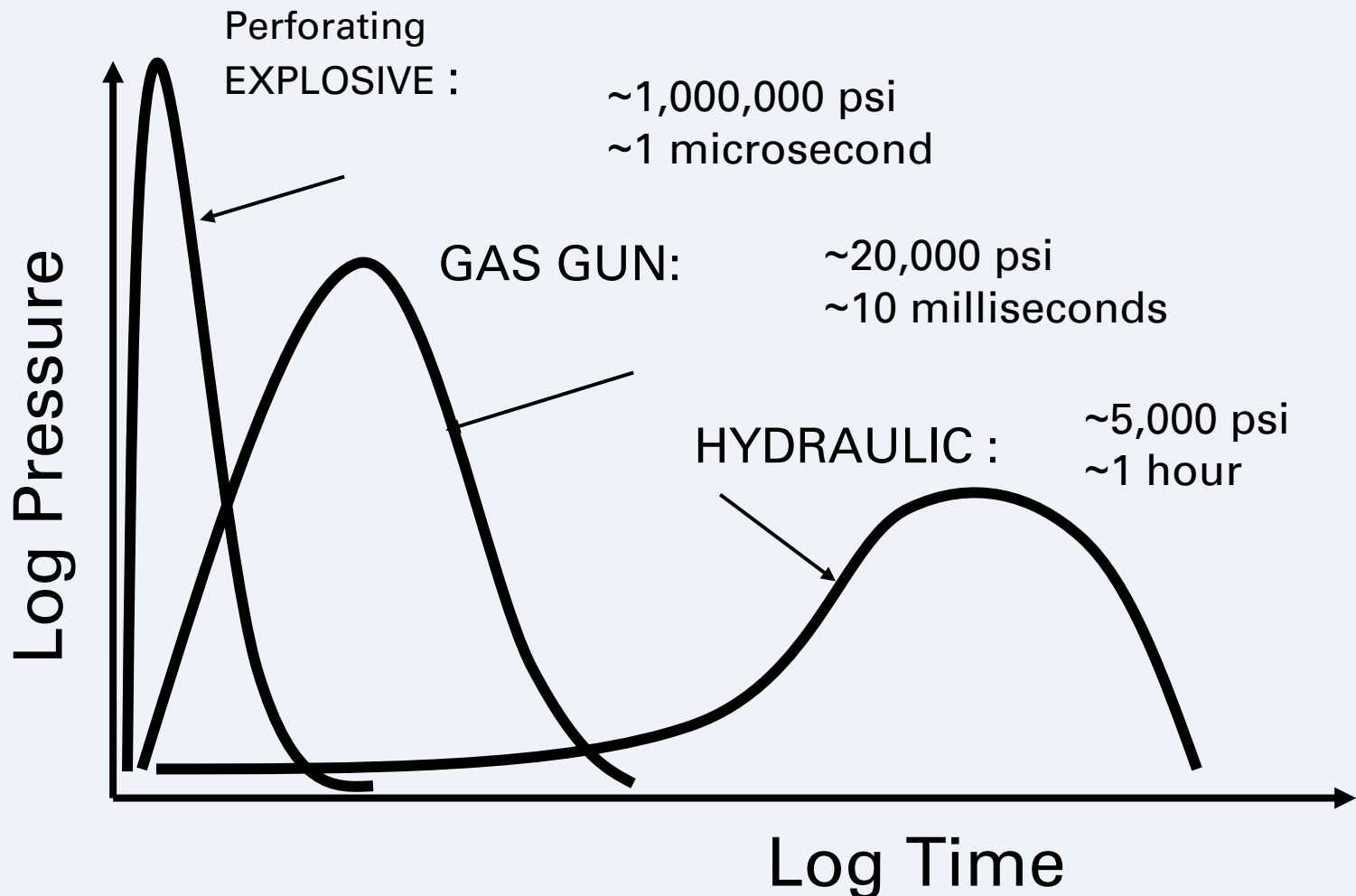
1. Deeper initial penetration.
2. More active perforated tunnels.
3. Cleaner tunnel with fractured tips that reduces the breakdown Gas Gun pressure.
4. Improve injection rates at minimum pressure for followed up acidizing job.
5. Ensures reliable fracture initiation and maximum fracture coverage

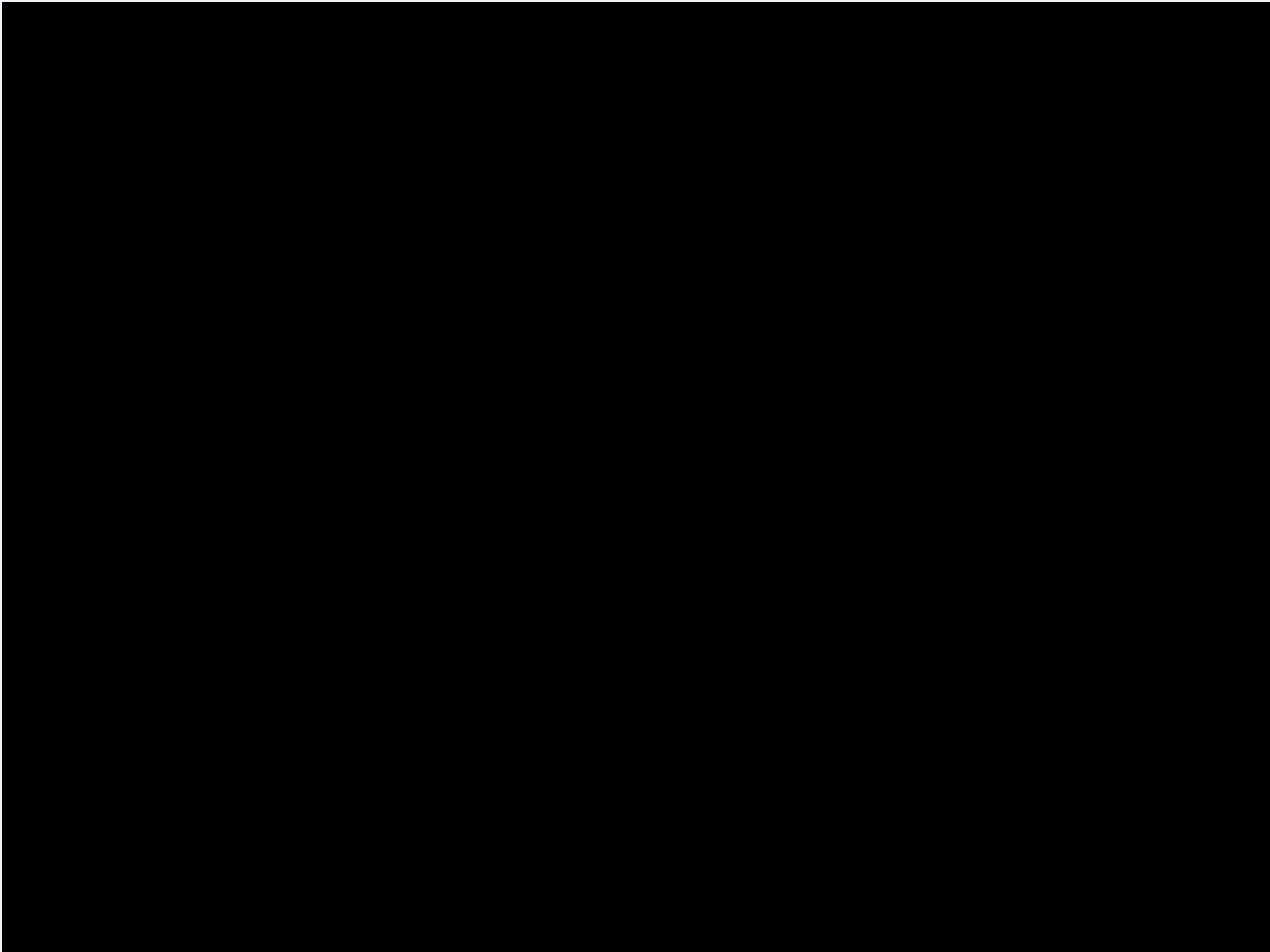


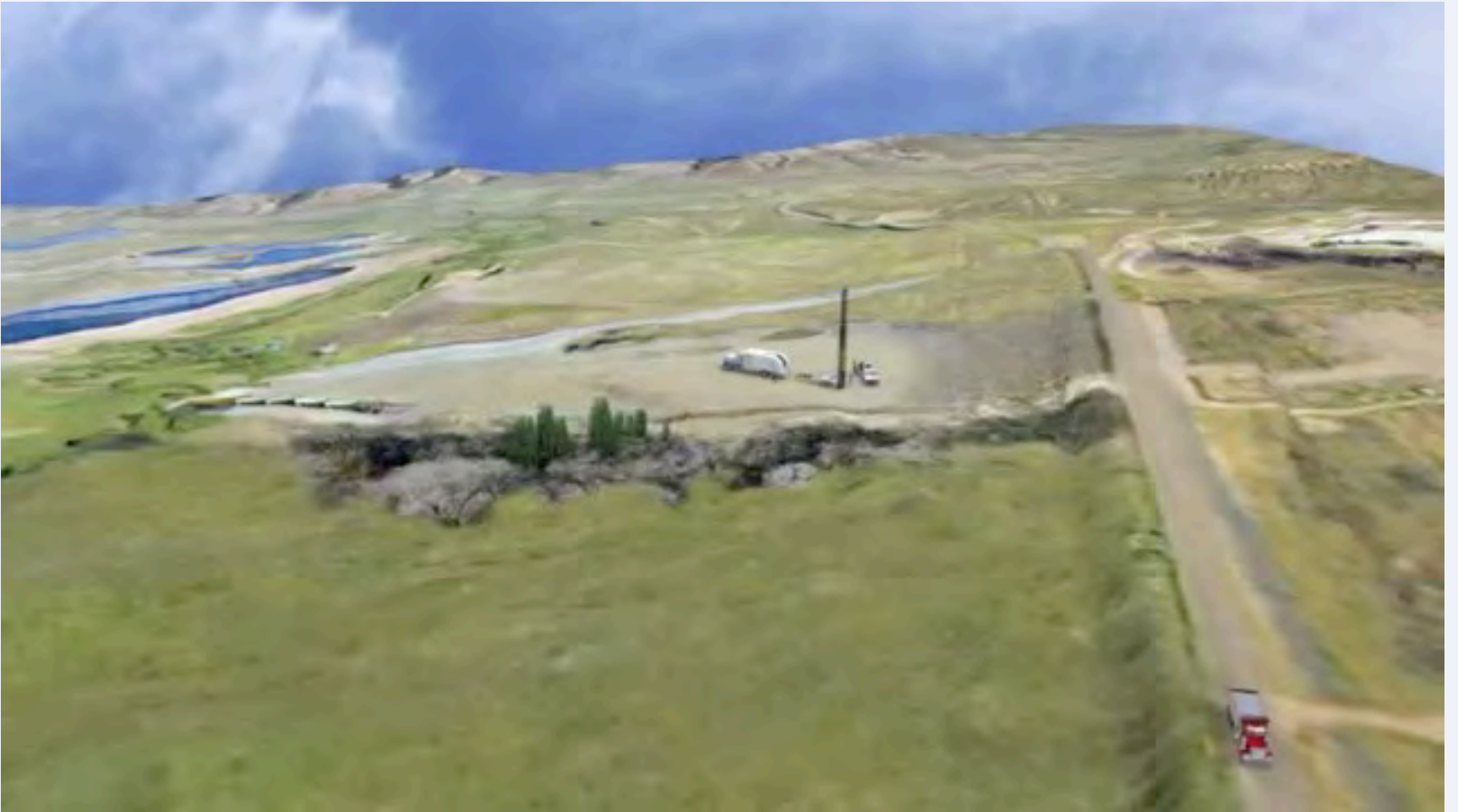
Utilizing the **Gas Gun**, The extra depth of the perforating tunnels over 20 ft. has tremendously assets the planned acidizing job improving the cleanout treatment process.



# The Theory is in the Pressure-time profiles of three stimulation methods









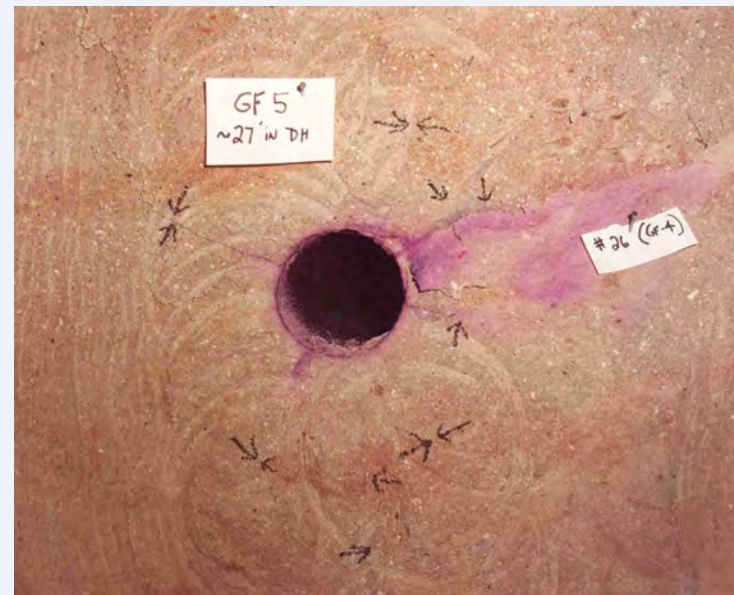
The **Gas Gun** propellant burning rates and pressure-time profiles are different from explosives and hydraulic fracturing so that it can create multiple fractures that are not governed by in-situ stresses. Hitting the undesired water zone is mostly unlikely.







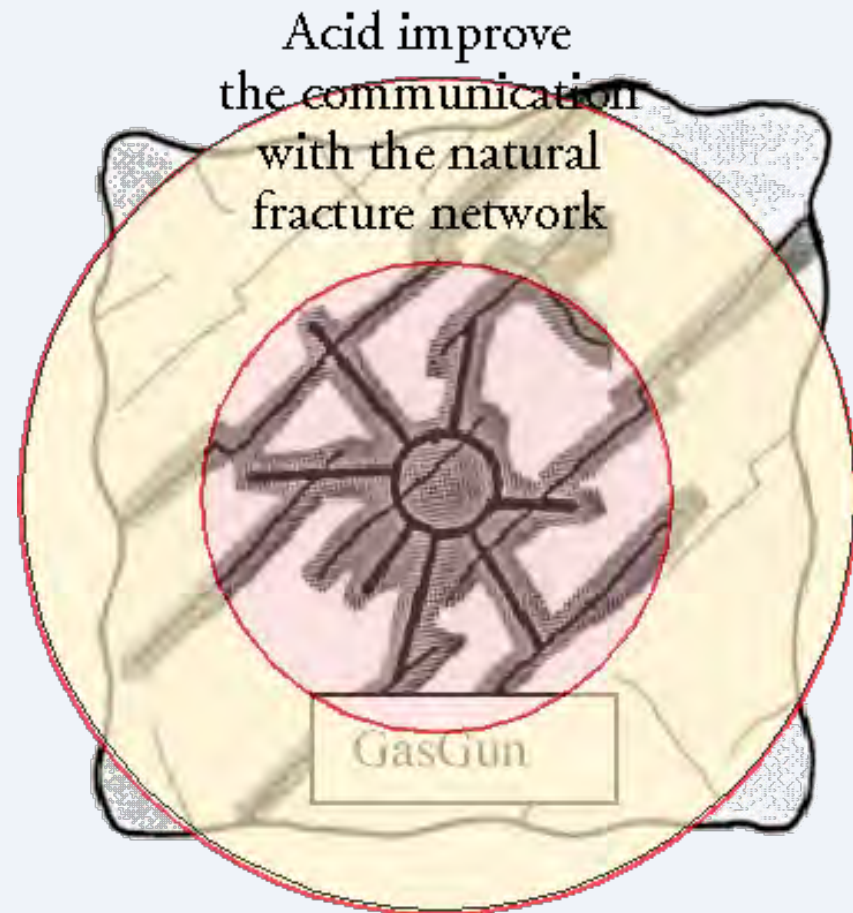
The Gas Gun



Other



**Volume of acid should fill the fracture pattern to a such distance to accommodate a good communication with the well bore.**





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**A Case Result:** A tremendous increase in production from adjacent well  
from 50 bbl. To 450 bbl.



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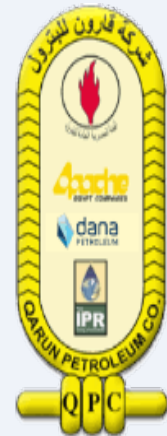
Enap Sipetrol



# References



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## Main Contacts

Eng. Hossam El-Atroush	<b>General Manager</b>	Mobile: +20 122 212 9554
Eng. Mohammad El-Atroush	<b>Deputy General Manager</b>	Mobile: +20 122 222 5758
Eng. Sherif Morsy	<b>Operations Manager</b>	Mobile: +20 122 222 3968
Eng. Talaat Rizk	<b>Business Development Manager</b>	Mobile: +20 122 140 4501





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**PDS**  
 Petroleum Development Services

**Address:**  
**1997**  
 Dubai Office  
 P.O. Box 144000, Jebel Ali  
 Dubai, UAE  
 Tel: +971-2-2500100  
 Fax: +971-2-2504111

**Manama Office**  
 P.O. Box 10000, Manama, Bahrain  
 Tel: +973-33666666  
 Fax: +973-33666666

**Riyadh Office**  
 P.O. Box 10000, Riyadh, Saudi Arabia  
 Tel: +966-11-2000000  
 Fax: +966-11-2000000





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# Q&A

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