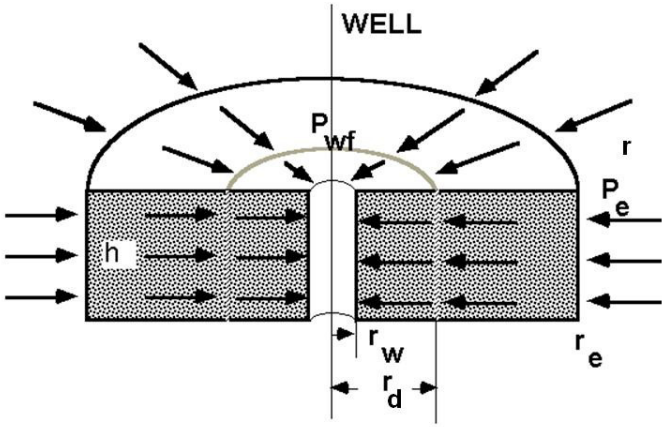
Maximizing Through Tubing Gun Performance in Dual Tubing Completion

Authors : Edo Raisa (Total E&P Indonesie)
Denny Gultom, Riko Mudayana (Schlumberger)

TOTAL

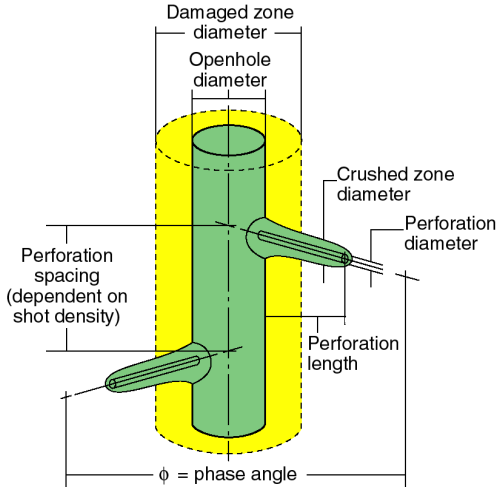
Schlumberger

Well Productivity Basic



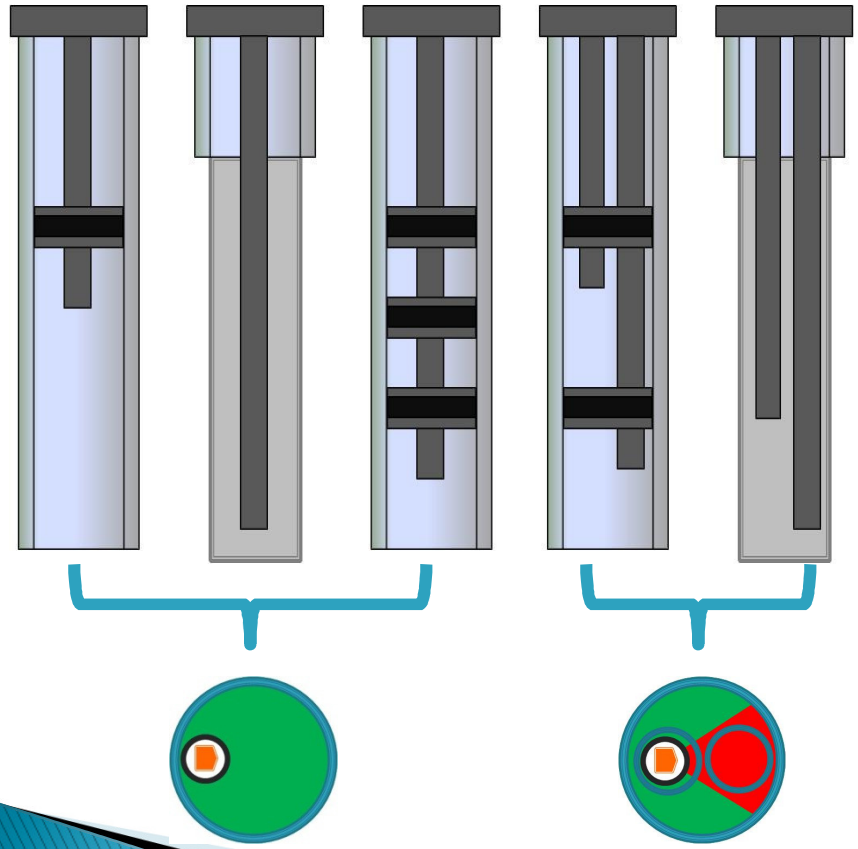
$$p_r - p_{wf} = \frac{141.2\, q\, B_o \mu}{kh} \left(\ln \frac{r_e}{r_w} - 3/4 + s_t \right)$$

$$PI = \frac{q}{p_r - p_{wf}} = \frac{kh}{141.2\, B_o \mu \left(\ln \frac{r_e}{r_w} - 3/4 + s_t \right)}$$



Gun Parameters
Penetration
SPF
Phasing

Completion & Perforation Options



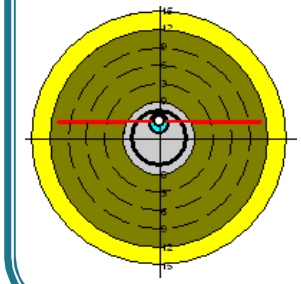
Perforation Options :

1. **Large size casing gun**
   - Wireline OB or TCP
2. **Through Tubing – Shot Inside Casing**
   - Exposed & Casing Gun
   - Oriented – non oriented
3. **Through Tubing – Shot Inside Tubing**
   - Exposed & Casing Gun
   - Oriented – non oriented

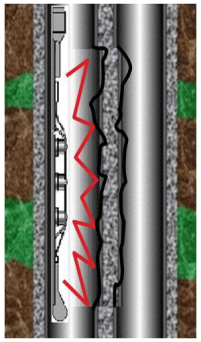
SAFE ORIENTATION

Perforation Challenges in Dual Tubing

Poor Performance



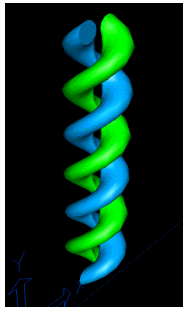
Tubing Damage



Gun Stuck

Debris Issue

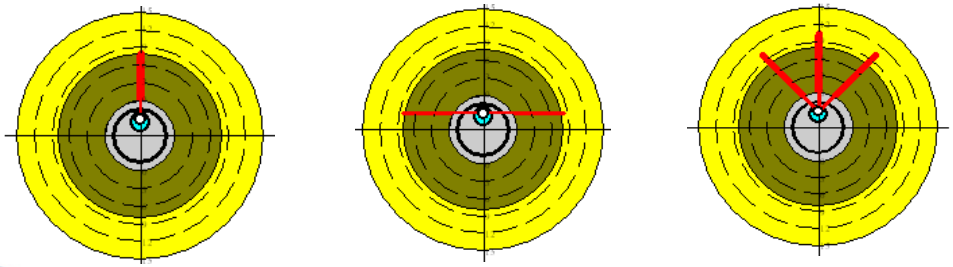
Twisted Tubing



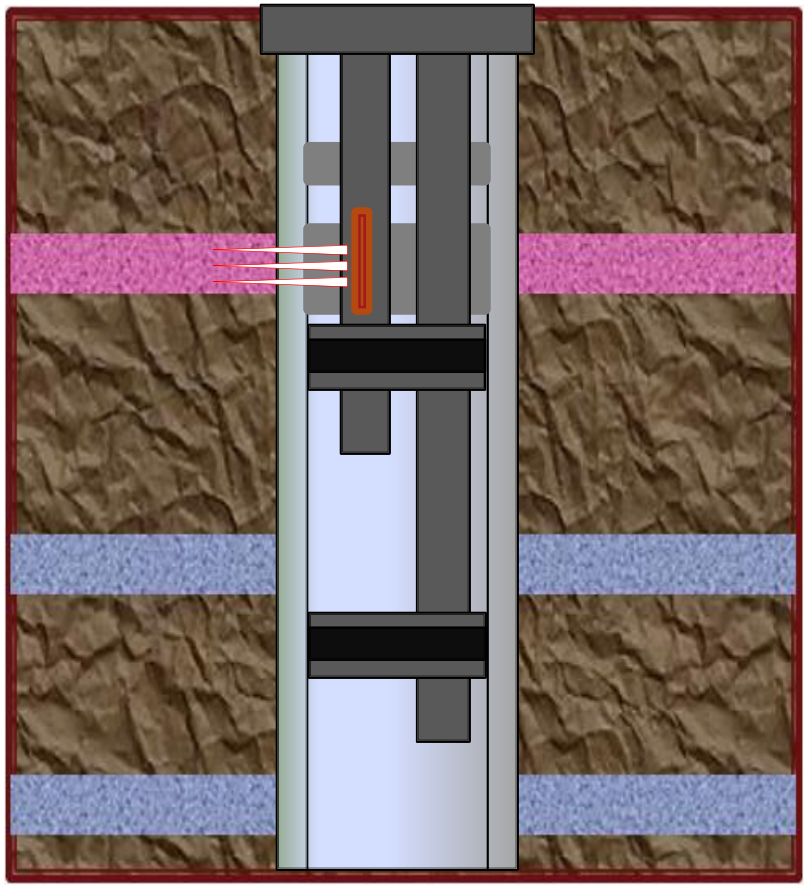
Preferred Option

Oriented Casing Gun Performance Progression

Orienting Device	60 Res	5 Res	5 Res
Gun Phasing	0 Phase	0-180	180+/-45
Penetration	Deep Chg	XDeep	RockDeep
Shooting Density	4 SPF	4 SPF	6 SPF



Case Study



Overview

- Open HC zone above top packer.
- Dual 3-1/2" Tubing in 9-5/8" casing.
- Cementing to ensure integrity.
- Top cement evaluation.
- Integrity test.
- Unload well for UB Perf
- Perforate with 2" Rock-Deep Charge, 6 SPF, 180 +/- 45 deg.
- POP

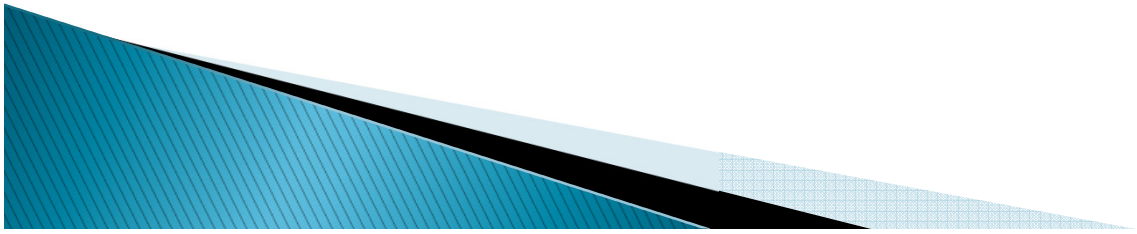
Well Information

Completion

Well Deviation:	0	deg	Drainage Area:	31.42	acre
Form Top (TVD):	1785.0	m	Dietz Shape Factor:	31.62	
Form Bottom (TVD):	1789.0	m	Formation Height (TVD):	4.0	m
Borehole Diameter:	12.25	in	Completion Percentage: (%)	100/100/100/100/100	
Wellbore Fluid:	Brine		Perf to Form Top (TVD): (m)	0.0/0.0/0.0/0.0/0.0	
Fluid Density:	8.763	ppg			

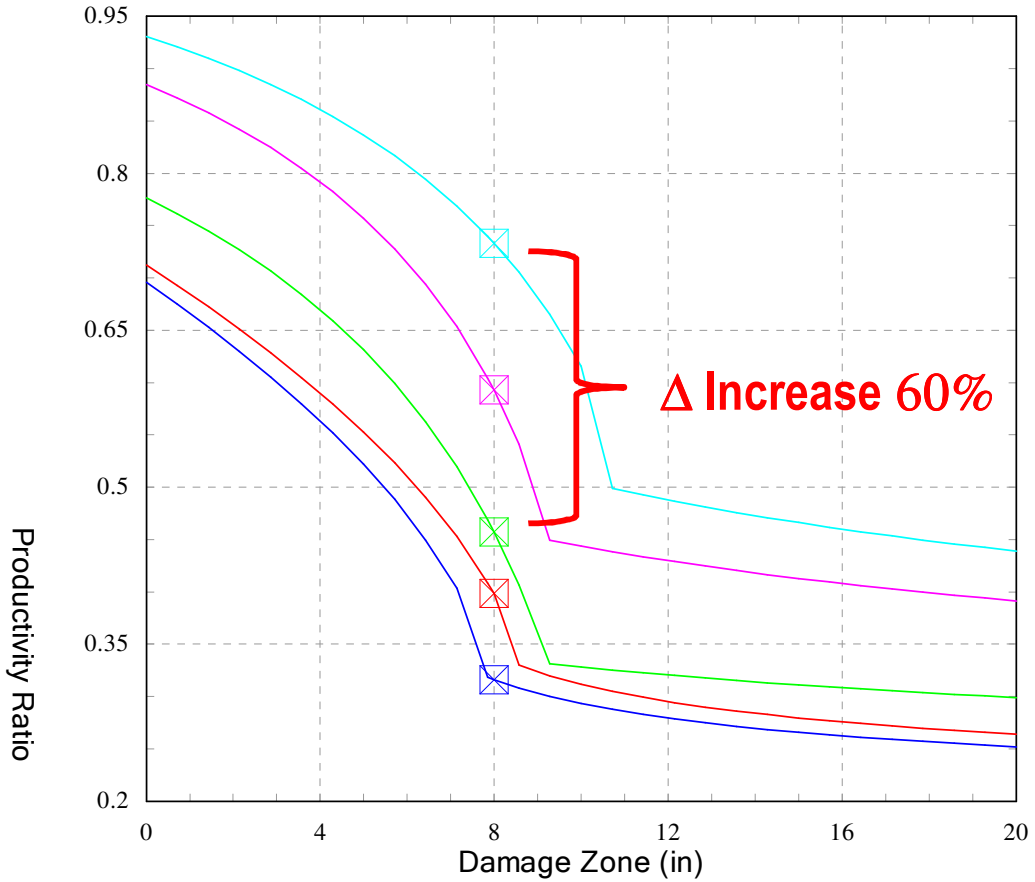
Formation

Rock Type:	Sandstone		Formation Fluid:	Oil	[GLR=436 SCF/STB]
Porosity:	17.0	%	Gravity (Density):	40.0	deg API
Horizontal Permeability:	300.00	md	Form Volume Factor:	1.18	bbl/STB
Vertical Permeability:	80.00	md	Viscosity:	0.60	cp
kd/k:	0.20		Pore Pressure:	1020	psi
Wellbore Damage:	8	in	Formation Temperature:	190	deg F



Perforation Simulation

Well was producing 2600 BFPD with 92% WC

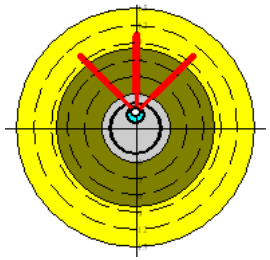


2" HSD, 4 SPF, 0 Phase, Deep Chg
2" HSD, 4 SPF, 0 Phase, XD Chg
2" HSD, 4 SPF, 180 Phase, XD Chg
2" HSD, 6 SPF, 180 +/-45 Ph, XD Chg
2" HSD, 6 SPF, 180 +/-45 Ph, RockD

Gun #	Phasing	Effect (spf)	kc/k	Form Pen/ Dia Avg (in)	Comp Len Avg (m)	Comp %
1	0 (360)	4.00	0.50	7.79/0.43 *	4.0	100
2	0 (360)	4.00	0.50	8.44/0.42 *	4.0	100
3	180	4.00	0.50	8.65/0.26 *	4.0	100
4	0,±45	6.00	0.50	8.68/0.38 *	4.0	100
5	0,±45	6.00	0.50	10.38/0.45 *	4.0	100

Conclusion

- The key elements to maximize perforating gun performance in dual tubing are :
  - High resolution gun orienting device
  - Deep penetration charge
  - Maintaining high shot density
  - Multi phasing perforation



- Good production result was achieved using 2” HSD, 6 SPF and 180+/-45 deg Rock-Deep Charge.

- Application is not limited to the dual completion but also monobore completion and possibility for further productivity improvement using dynamic under balance technique.

Thank You

Question & Answer