

APPS-13-017: Rigless TCP Techniques

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Author: Saurabh Dabra, Baker Hughes
Clifford McNaught, Baker Hughes
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Well Scenario

Monobore Injector (4-1/2" Casing) wells to be perforated Rigless with N₂ underbalance.

- Long Intervals (typically 70m+) to be perforated per well.
- Gun assemblies to be left in the well after perforation.
- Deployment to be done using Crane.
- The TCP guns were deployed using E-Line as conveyance mechanism and set on bottom Gun Anchors.
 - Setting the Gun Anchor required lateral movement and E-line was released from gun string using Mechanical Release Tool.
- Hydraulic firing heads (absolute pressure actuated) were used.

Well Scenario

Monobore Injector (4-1/2" Casing) wells to be perforated Rigless with N₂ underbalance.

- Perforation was done by pressurizing the entire monobore column using N₂.
- TCP assemblies with gun anchors did not drop after perforation.
 - It was observed that improper clean out, long exposure of anchors to well bore (typically 3~4 months) prior to perforation lead to settlement of debris.
- TT Fishing tools were utilized to latch on to the TCP assemblies and run them to the bottom of the well.

Solution Implemented

As an alternate to Gun Anchor based system, the following system was implemented:

- Coil Tubing Conveyed Perforation (CTCP) Shoot & Drop using GS Spear fishing tool.
- This was to be the first job performed by BHI using this technique worldwide.
 - Subsequently 30 jobs performed successfully using this technique.
- Intelligent Coil used for depth correlation.
- Is cost effective, easy, reliable & can be used at Rigless sites.
- Does not require to check if guns have dropped or not, there by preventing a run by slickline.

BHA – CTCP Shoot & Drop

WELL PROFILE		BAKER HUGHES TCP SYSTEMS		Gun Size	2-7/8"	
		Customer Country Date 11-Oct-11		Phasing	60	
				S.P.F.	6	
Field: Well No.		Fluid Type WATER		Gram wt:	17.5	
				Charge Type	Predator XP	
Rig Name Rigless		Total Shots TBA		PBD / Mts		
				BHT / C		
Perforation Intervals:		Fluid Weight 8.34		Max Well Deviation	37.2	
				Zone Dev.	34.6	
Perforation Intervals:		TVD 1115		Hydrostatic Pressure		
				From	To	1537
Perforation Intervals:		Size 4.5"		Surface		
				From	To	Surface
Perforation Intervals:		Weight 12.6 pcf		Casing		
				From	To	Surface
Perforation Intervals:		Weight 12.6 pcf		Liner		
				From	To	Surface
Perforation Intervals:		Weight 12.6 pcf		Wkstrg		
				From	To	Surface
Item No.	Item Description	ID	OD	Length	Ass. Length	Depth
24	Bottom of the Assembly					1366.33
1	Bull Plug		2.38	0.05	0.05	1366.28
2	Bottom Sub		2.38	0.18	0.23	1366.10
3	Loaded Gun		2.38	1.70	1.93	1364.40
4	Blank Gun		2.38	12.00	13.93	1352.40
5	Loaded Gun		2.38	3.40	17.33	1349.00
6	Blank Gun		2.38	2.00	19.33	1347.00
7	Loaded Gun		2.38	5.10	24.43	1341.90
8	Blank Gun		2.38	9.20	33.63	1332.70
9	Loaded Gun		2.38	3.60	37.23	1329.10
10	Blank Gun		2.38	2.80	39.83	1326.50
11	Loaded Gun		2.38	6.70	46.53	1319.80
12	Blank Gun		2.38	3.90	50.43	1315.90
13	Loaded Gun		2.38	4.50	54.93	1311.40
14	Blank Gun		2.38	2.60	57.53	1308.80
15	Loaded Gun		2.38	4.90	62.43	1303.90
16	Blank Gun		2.38	10.20	72.63	1293.70
17	Loaded Gun		2.38	3.50	76.13	1290.20
18	Blank Gun		2.38	4.90	81.03	1285.30
19	Loaded Gun		2.38	6.50	87.53	1278.80
20	Safety Spacer (Including FHA)		2.38	5.36	92.89	1273.44
21	Model RD Firing Head		3.13	1.07	93.96	1272.37
22	Model D Firing Head		3.13	1.09	95.05	1271.28
23	GS Profile Sub 2-3/8" EUE pin	1.97	3.75	0.48	95.53	1270.80
24	GS Spear Tool 1.5" AMT Box	0.25	2.70	0.26	95.79	1270.54
25	Coll Tubing Tools				95.79	1270.54
26	CT to Surface				95.79	1270.54
27						
28						
5						

All Depths Are To Top of Item

4	Comments:	Total Weight of items 1 to 23 = 4000 LBS
3		Length of Fish : 97.29 mts (From Bull Plug to GS Profile)
2		GS Spear Tool 1/4" circulating port
1		Model RD Firing head will be installed with 14 min time delay
		Model D Firing head will be installed with 14 min time delay

BHA Configuration (Bottom to Top)

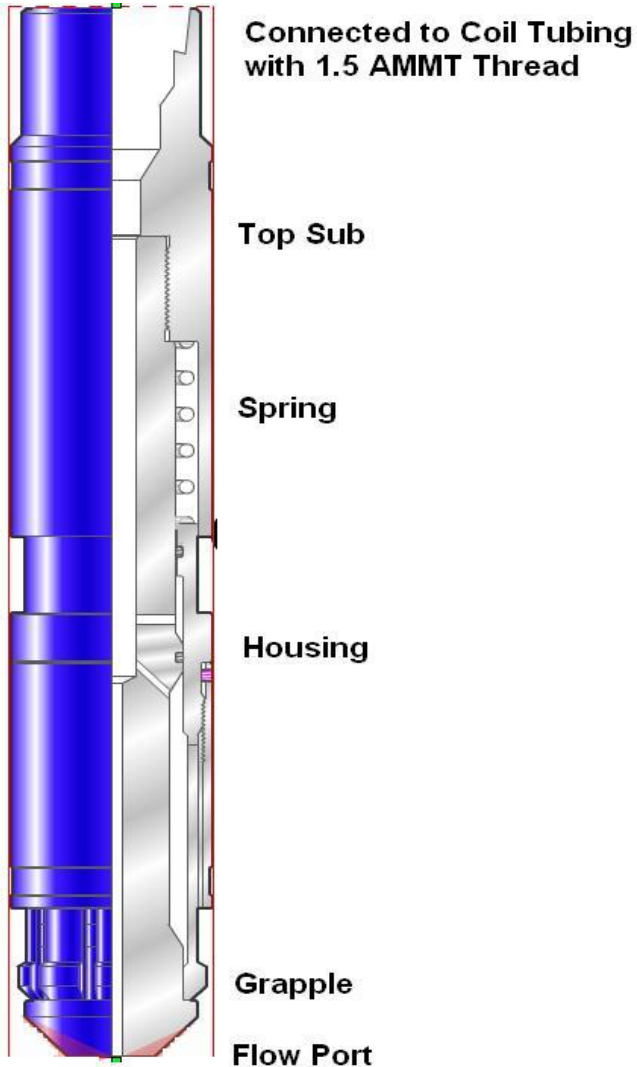
- Bull Plug
- Guns
- Safety Spacer (min 10 ft)
- Hydraulic Firing Heads
- Bait Sub / GS Profile Sub
- GS Spear tool (drop point)
- CT BPV + MHA + Connector
- CT to Surface

****Dropped in the well****

****Recovered from the well****



BHA Components



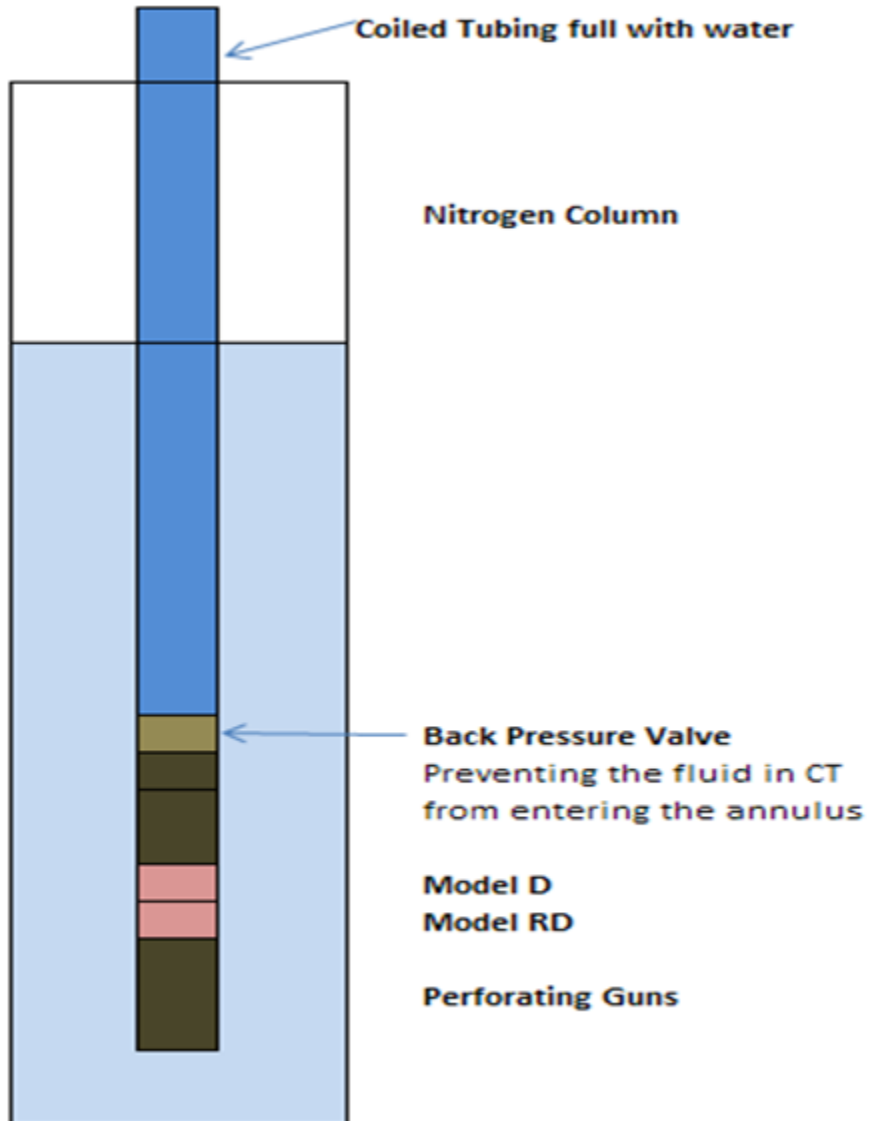
- Thru Tubing Fishing GS Spear tool
 - A Standard & Successful Fishing Tool.
 - Flow Thru to release.
 - Ideal for this type of operation.
 - Connected to CT with 1.5” AMMT.
 - Engages to the TCP string using Bait Sub.

BHA Components



- Bait / GS Profile Sub
 - Standard 3.0" Fishneck
 - Connects directly to firing head
 - Is left behind in the well as top most part of the string
 - Can be used as fish neck if TCP string is desired to be recovered in future

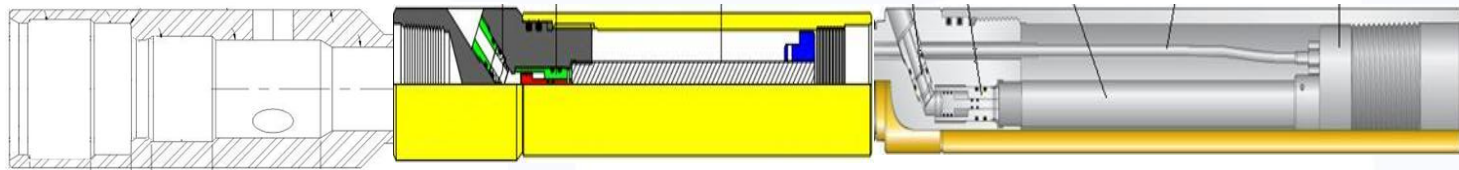
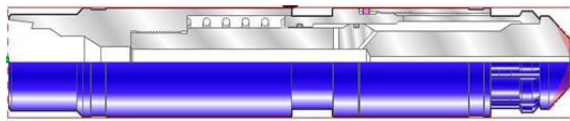
Underbalance



- The N2 underbalance is achieved by using BPV (differential pressure operated back-pressure valve). Typically set at 1500 psi +/-.
- The guns are run to the depth.
- Annulus of CT is pressurized to perforating pressure.
- CT is pressurized against BPV to prevent from it collapsing
- BPV also prevents the CT fluid from entering the annulus thereby maintaining the underbalance before perforation.

Release Function

3" GS Spear tool – Flow
Thru to Release



Bait Sub

Hydraulic FH

Hydraulic FH

Challenges

- Perforation debris sometimes get stuck in the grapple and/or in the flow ID thus prevents guns from releasing in first attempt.
 - Making multiple release attempts add to the CT fatigue.
 - No of release attempts are limited to 10.
- If Flow release mechanism fails, ball has to be dropped to actuate the contingent release mechanism in CT tools.
 - Resulting in LIH of CT MHA + BPV + Conenctor & GS Spear.
- Flow release takes place through 0.25” ID results in high pressures in CT.
 - 4200~4500 psi. CT Tool max pressure rating is 5000 psi.
- Guns have to be perforated the same day when RIH.

Overcoming Challenges



- Inter Gun Automatic Release (IGAR)
 - Tool philosophy
 - Simple design based on proven TCP “Modular Automatic Gun Release” (MAGR).
 - Provides redundancy in the CT Shoot & Drop System.
 - IGAR is the primary release mechanism.
 - GS Spear is back-up release option in this scenario.
 - Reduces the length of fish dropped in the well
 - Firing heads are recovered in every run (by approx 6 m per well).
 - Less prone to wellbore debris.
 - Successfully implemented

BHA – CTCP Shoot & Drop with IGAR

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		Customer		Phasing	60	
		Country		S.P.F.	6	
		Date		Gram wt:	17.5	
		11-Oct-11		Charge Type	Predator XP	
		Field:		PBT / Mts		
		Well No.		BHT / C		
		Fluid Type		Max Well Deviation	Zone Dev.	
		WATER		37.2	34.6	
		Rig Name		Fluid Weight	TVD	Hydrostatic Pressure
		Total Shots		8.34	1115	1537
Rigless		Performance Intervals:				
TBA		Size	Weight	From	To	
		Casing	4.5"	12.6 ppg	Surface	PBTD
		Liner				
		Wkstrg				
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BHA Configuration (Bottom to Top)

- Bull Plug
- Guns
- Safety Spacer
- IGAR

- Blank Gun (7 ft / 4 ft)
- Model RD & D Firing Head
- Bait Sub / GS Profile Sub
- GS Spear tool
- CT BHA
- CT to Surface

****Dropped in the well****

****Recovered from the well****

Safety Spacer + IGAR + Blank Gun to be 10 ft min



Challenges – The Next Level

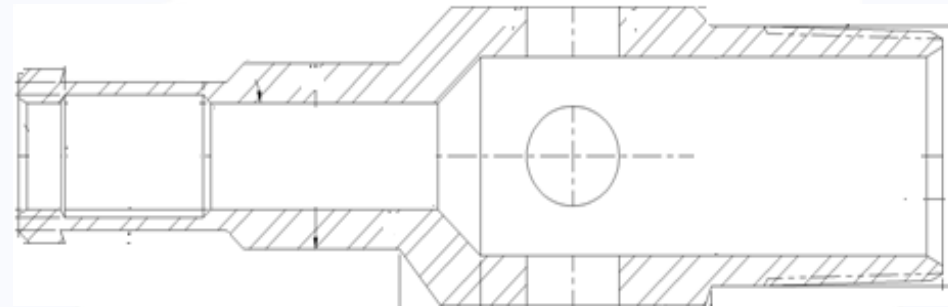


GS Spear has:

- Exposed Grapple
 - More prone to wellbore debris
 - More prone to perforation debris
- If debris get stuck in grapple
 - Will require multiple release attempts to be made
 - Can lead to LIH of tool string if failed to release.

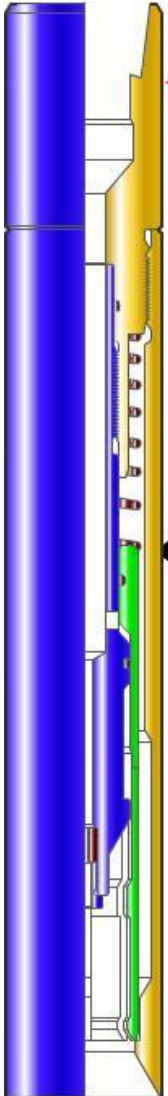
Mitigating The Next Level Challenges

3" Thru Tubing Fishing GS Spear tool



**Bait Sub / Fishneck with
1.75" External Profile**

BHA Components



- 1.75" TT Fishing Hydraulic Release Overshot
 - Can we use it as a running tool?
 - Can we use it as a releasing / disconnecting tool?
 - Yes
 - The overshot is based on the same mechanical principles as the spear; only difference being one is a spear, the other is an overshot. If the spear withstood perforating impact so far, the overshot should as well.
 - What if it doesn't bear the impact?
 - Who cares, we have to drop the string anyways!
 - The tool does not have a exposed grapple.
 - Less prone to debris.
 - Widely used fishing tool for external fishneck.

THANK YOU

Questions?...Comments?
Discussion?

