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Fishing Job using Expandable Thru Tubing Fishing Tool to Catch Slickline Fish (Wire) inside 7" Casing (Success Story from Gas Well)

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Abstract.
This paper presents success story about fishing 543 m of 0.125" slickline wire inside 7" casing of gas well (6.184" inside diameter). The well has completion string that consists of 4.5" tubing with minimum restriction 3.826" and Wireline Entry Guide at depth 2,305 meter. The top of fish is predicted at depth 3,068 meter. The fish was left in hole when slickline wire broken off in the middle of Pressure and Temperature Survey. Before the fish happened, the well was being planned for a perforation job. The objective of the fishing job is to ensure the well is clear from any obstruction that can put at risk that job. Therefore, the fishing tool must be designed to be able to run through 3.826" inside diameter and expand to 6.184". The design incorporates metal fingers that can expand by slight jar actions. However, the metal fingers are flexible enough to be pulled out through restriction inside the wellbore.

Fishing job included several critical activities: pre-work tubing clearance, tool-string selection catch the fish and retrieve out of hole, break up and connection surface lubricator to free the wire from x-mas tree while maintaining well pressure controlled. Braided line was used to have more strength to retrieve the fish.

The procedure was carefully reviewed and executed to avoid create another fish left in the hole. At the end, 540 m of wire-fish was able to retrieve. Another 60 m was left in hole because it was no longer affect the planned workover. The fishing tool has successfully performed the intended job. The thru tubing fishing job is inexpensive and able to create economic opportunity to execute the planned workover.

The proudest thing of this subject is the fishing tool is made locally by national industry which its design is derived from analytic thinking and collaboration to solve problem.

This paper will be beneficial because this paper summarizes what a successful fishing job with a unique technical approach from planning until execution and will provide detail yet brief the actual fishing job for similar activities in the future.

Keyword(s): Fishing, Slickline, Braided Line, Fishing Tool.

1 Background

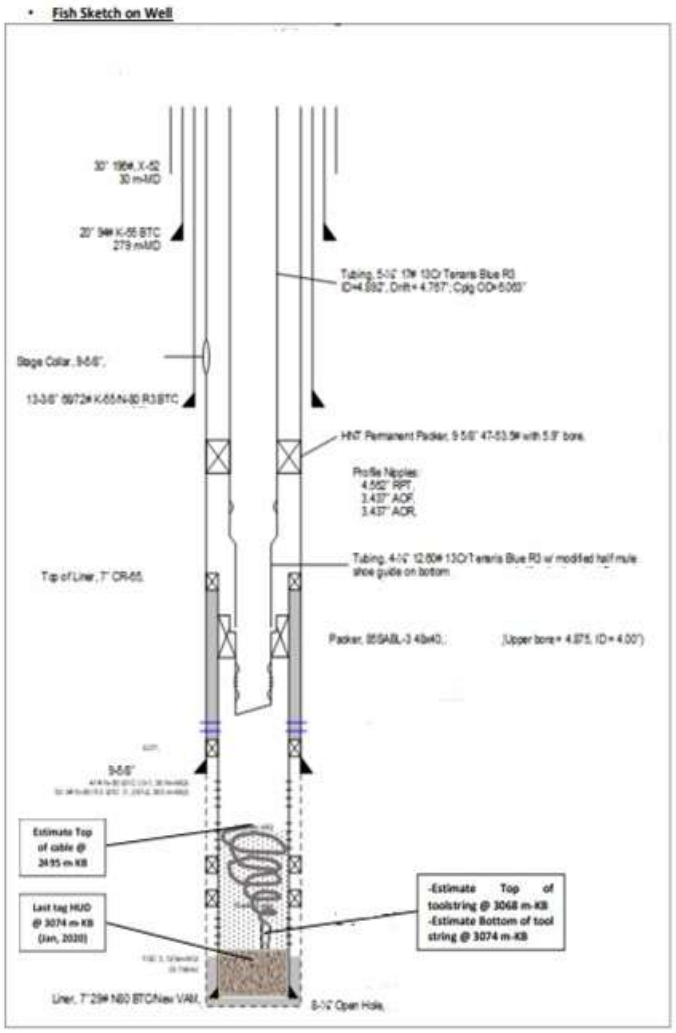

Figure 1. Mechanical Status after Wire Parted (Simplified, Not to Scale with Significant Depth Markers have been erased).

SBN-0x is a gas well in South Sumatera. The well can produce up to 30 mmscfd, 2xx BCPD, 2xx BWPD with 9xx psi FWHP (Flowing Well Head Pressure) and 255 deg F FWHT (Flowing Well Head Temperature) from commingle reservoir: BRF, TA, PT Reservoirs. The well also has 5.5% CO2, 10 ppm H2S, 35x deg F BHT (Bottom Hole Temperature) and 272x psi BHP (Bottom Hole Pressure) at 3,0xx m-KB.

In January 2020, the P&T (Pressure & Temperature) Survey was performed with EMR (Electronic Memory Recorder). When performing second FGS (Flowing Gradient Survey) ~ after completion of SGS (Static Gradient Survey) & the first FGS ~ the wire was parted suddenly at depth 3,07x m-KB in the middle of ramping up gradually gas production to 100% choke opening prior to perform logging up stationary survey. After the remaining wire was spooled back on surface to slickline unit's drum, it was found that the situation created fish of 600 m 0.125" slickline and 22 ft of EMR tool string. Figure 1 shows the mechanical status after the wire parted.

The remaining wire then was analyzed. The analysis included Chemical Composition Analysis, Visual and Stereomicroscopy Examinations. Chemical composition analysis showed that actual chemical composition complied with material specification as shown in 'table 1'.

Table 1. Chemical Composition Analysis

Element	Composition, wt.%		
	Actual Wire	Material Certificate	Specification (UNS S32760)
Carbon, C	0.023	0.021	max. 0.03
Silicon, Si	0.23	0.2	max. 1.0
Sulphur, S	0.0023	0.0003	max. 0.03
Phosphor, P	0.032	0.025	max. 0.03
Manganese, Mn	0.53	0.57	max. 1.0
Nickel, Ni	6.54	6.97	6.0 – 8.0
Chromium, Cr	25.33	25.15	24 – 26
Molybdenum, Mo	3.37	3.87	3.0 – 4.0
Copper, Cu	0.52	0.56	0.5 – 1.0
Tungsten, W	0.61	0.52	0.5 – 1.0
Nitrogen, N	Not detected	0.23	0.2 – 0.3
Iron, Fe	Balanced	Balanced	Balanced

Visual and Stereomicroscopy examinations were quite interesting. It was like forensic to determine what happened with the wire in the borehole.

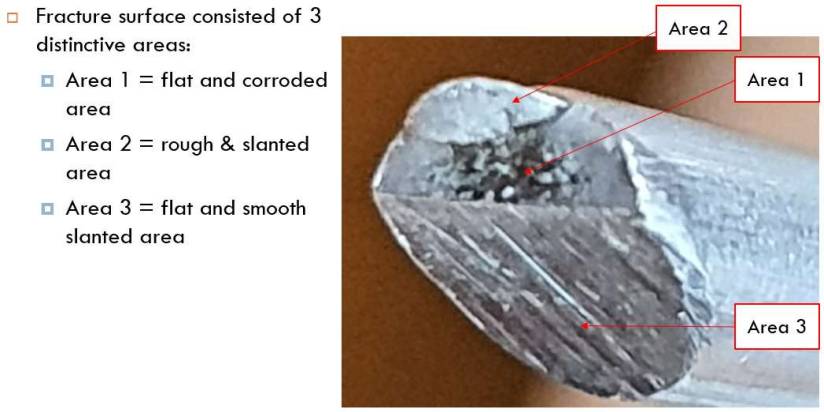

Figure 2. Visual & Stereomicroscopy Examinations

Visual examination on Area 1 strongly indicated high cycle fatigue fracture surface. It could be related with running hours from previous jobs or contracts with other company. This area was observed with moderate corrosion. Visual examination on Area 2 indicated final failure fatigue crack propagated from Area 1. Visual examination on Area 3 did not indicate corrosion or fatigue crack, only fine grinding. It was speculated because of friction with tubing wall when the remaining wire was being pulled out of hole.

Beside field tensile test before the job as shown in ‘figure 3’, the mitigation to avoid similar situation happen is by using Edy Current Examination on wire prior the wire being used for the job. The example of Edy Current Examination can be seen in ‘table 3’. If Edy Current Examination discovers defect, then the wire should be considered not to be used.

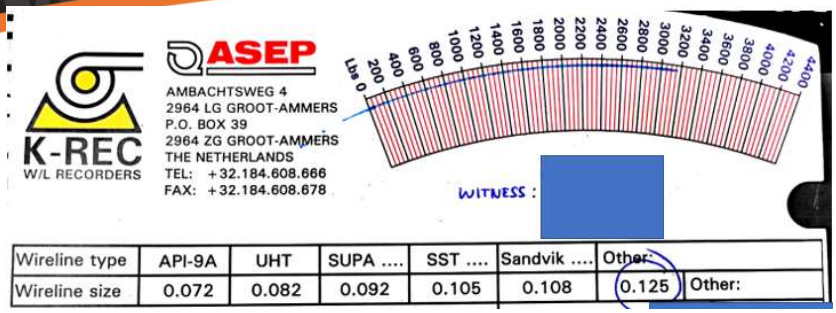

Figure 3. Example of Tensile Test

Table 2. Example of Edy Current Examination

Batch Name:		
Part no.: 1	10 Jul 2020 16:32:47 - 10 Jul 2020 18:12:49	
Sort: S2	Length: 2993.097 m	Alarm Counters: A: 0 B: 0 C: 607 D: 0 E: 0 F: 0 G: 0 H: 0

2 Methodology

Top of fish was predicted at depth conservatively 2,49x m-KB. It consisted of 600 m of 0.125" slickline and 22 ft of EMR tool string and it was located inside 7" casing with inside diameter 6.184". To prepare a fishing procedure, several issues must be resolved:

a. Fishing tool must have ability to pass 3.437" and enlarge to 6.184".
b. This fishing job should not create another fish left in hole.
c. How to safely spool the wire-fish on surface.

The fishing job must be conducted on day light to avoid HSE risks particularly with gas suspension near ground at night time.

The fish has weight 453.5 lbs. The selected wire for fishing is 7/32" braided line with safe breaking load 5,000 lbs which is sufficient to hold weight of the fish and the braided line will not break in case of hard pulling. Lubricator must be long enough to cover all fish and fishing tool string. Operator must consider crane ability, x-mas tree height, lubricator stack-up length before any slickline/wireline job particularly fishing job.

For this fishing job, tool string configuration was 7/32" rope socket, swivel, accelerator, knuckle joints, 5ft roller stem, Power Jar, Tubular Jar, 2 ft solid stem, 2.5" Quick Lock Sub x 1-11/16" SRT, the fishing tool with total weight 684 lbs and total length 39.5 feet. Two wireline BOPs were used as double barrier since master valves (on x-mas tree) would be capped and the selected slickline unit had two drums for 7/32" braided line and 0.125" slickline unit. Besides, master valves are not recommended to close against wire across them. Since 7/32" braided line was run with grease injection wireline valves, 0.125" wire-fish would be spooled with slickline stuffing box. Operator must pay attention – not only to perform fishing activities in the well bore – this surface activities. Many risks should be mitigated by operator such as pinch point, line of fire, gas suspension on surface, etc.

The fishing tool is designed together with one of local company and we came with a fishing tool with 3.113" OD. It has hammer-like mechanism that when it is jarred down, the energy will travel down with momentum to the anvil and release the fingers from the centered-lock to expand. Once it expands yet if failed to catch the fish, the fishing tool must be pulled out of hole and close on surface before running again for another attempt. However, this paper will only provide technical information at some degrees.

Without inventing this fishing tool, the available fishing tool will be a fixed diameter wire grabber and the OD (outside diameter) of it will be limited by minimum restriction in existing completion string. Because the well is a vertical well, in most likely case, it is expected the fixed diameter wire grabber will not catch the wire.

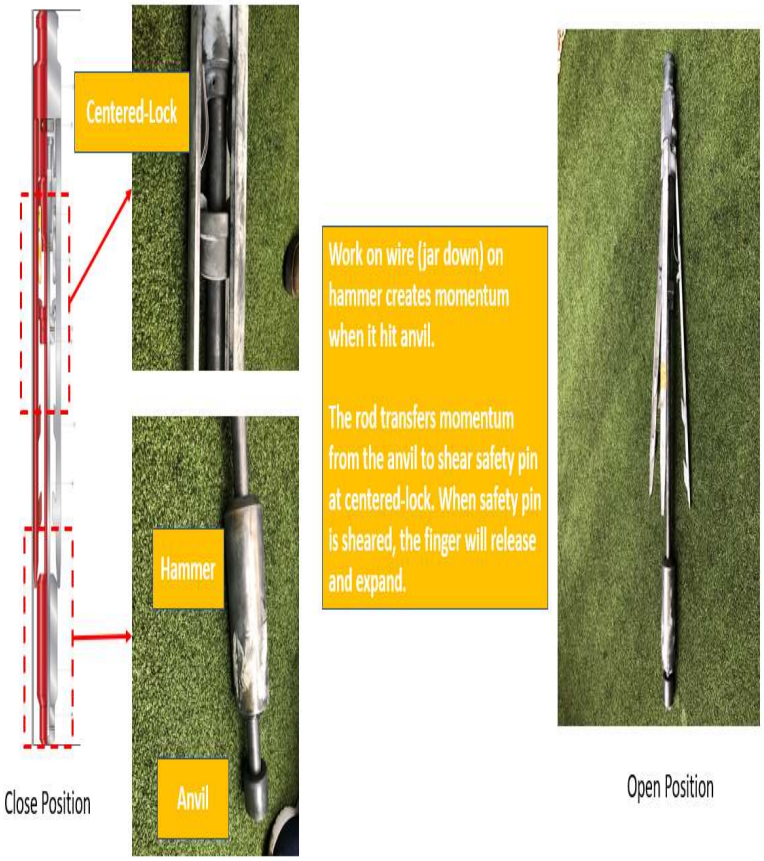

Figure 4. The Expandable Fishing Tool

After all technical aspects had been considered and risk had been mitigated, the fishing procedure was developed as follow:

a. R/U 7/32" braided line lubricators as per 'figure 5'.
b. Perform tubing clearance and depth correlation by tagged nipple profile inside completion string.
c. RIH (run in hole) fishing tool and open fishing tool's finger below EOT (End of Tubing).
d. Continue RIH until tag top of fish which can be observed from reducing of running weight.
e. Once fishing tool catches the wire-fish, pull out slowly.
f. When the fishing tool is above upper BOP, open and lay down braided line lubricator.
g. Manually, release the wire-fish from fishing tool and passing the wire into 0.125" slickline lubricator and its stuffing box.
h. Connect 0.125" slickline lubricator on top of upper BOP as per 'figure 6'.
i. Knot the wire fish and spool the wire fish to 0.125" slickline drum.
j. R/D all equipment.

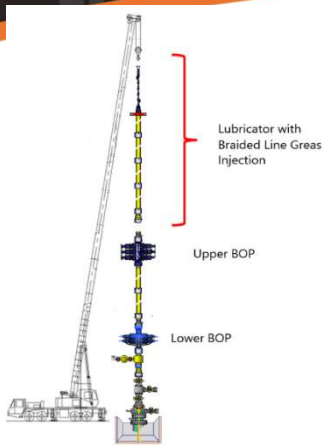

Figure 6. Braided Line Lubricator Stack Up

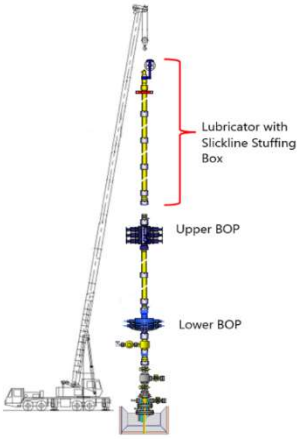

Figure 5. Slick Line Lubricator Stack Up

Actual condition on surface could push operator to adapt and deviate from the procedure. Operator may find the wire-fish came out like birdcage. For that case, the wire-fish couldn't be spooled in to 0.125" slickline drum. Clear the fishing tool from wire-fish and continue RIH fishing tool. It is a lengthy job and operator must be patient to do follow and repeat developed procedure. However, operator must consider having kill point when the job must be stopped, either cost or operating days.

Fishing job can be a lengthy and costly job. It is important for any fishing job to:

a. Have clear objectives why fishing job is a must.
b. Develop a procedure that is expected not to create another fish left in hole after considering all technical aspects and risks.
c. Be ready with contingency plan and required equipment. The only expensive job is the unprepared job.
d. Being patient, flexible and adaptable with actual condition. However, prepare with kill points when the fishing job must be stopped.

3 Result

Figure 7. Actual Fishing Activities on Location

Total of 543 meter of wire-fish could be recovered from 600 meter of wire-fish. The EMR tool string couldn't be fished, and it was decided to be left in hole because the job had acquired the objective to clear target depth from the fish for future perforation job. Effective fishing job duration is 11 days including rig up and rig down all equipment. 'Figure 7' shows a glance of the fishing job.

Left to Right: (1) Crew was checking all equipment after rigging up all equipment. (2) Fishing tool condition when missed the wire-fire after unsuccessful attempt. (3) Fishing tool condition after catch the wire-fish. This was the last birdcage before finally able to spool the wire-fish into slickline drum.

4 Conclusion

To fish out the fish that standard marketed fishing tools can't; some points should be seriously considered and emphasized such as:

a. The Gravity and The Momentums
   Any slickline equipment can only move downward or upward inside the wellbore. Without helps of electric line's motor or hydraulic pressure activated motor like coiled tubing - conveyed fishing tool, the fishing tools must be designed to translate the gravity and the momentums into actions such as opening and closing the fingers of fishing tool.
b. How The Fish Laid in The Wellbore
   There are only two possibilities of how the fish laid in the wellbore: sticked or centred to casing wall. Focus on sticked fish to casing wall.
c. Fail Safe Feature
   Not every fishing job is a successful one. However, ensure to have "fail safe feature" in the tool string configuration to avoid leave another fish in the wellbore.
d. Minimum Restrictions and Mechanical Limitations
   This expandable fishing tool is designed to be thin enough to pass the smallest restrictions, thick enough to not bent when dragging along the casing and tubing, short enough to be entered into lubricators, long enough to be expanded to casing walls, light enough to be pulled out, and heavy enough to be jarred down. Basically, every mechanical aspect should be balanced. To create the prototype and to perform surface test are highly recommended to test ideas and to fix the errors before use.

Acknowledgement

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