



Knowing Your Options When Attempting to Sidetrack in Open Hole

Danny Harrell, Greg Nairn, and Rocky Seale-Smith International Inc.

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Abstract

Generally when problems arise in drilling operations the probability of recovering the fish is small initially and decreases with time. It has been this lack of success coupled with the associated risk and economics that have made fishing in these applications negligible. Often it is opted to abandon the fish and sidetrack immediately. These decisions are based on the overall drilling economics, taking into account are the total operational cost versus the cost of the tools left in the hole.

In most drilling applications the risk and economics associated with open hole fishing dictate alternate methods should be evaluated to re-establish drilling operations. Setting a cement plug has been the proven method of choice over the years due to risk, technology, and ease of installation. However, in today's complex drilling environment, multiple cement plugs are often required to obtain a successful sidetrack, this is both costly and time consuming. This paper will discuss alternate open hole sidetracking methods and case histories. These new methods in comparison to cement plugs are proving to be faster and more economical.

Introduction

Over the last decade, open hole fishing has been reduced or eliminated due to the associated risk and economics. When problems arise in drilling operations it is typically feasible to make only several trips in the hole to try and recover the fish. Typically the only feasible option is to abandon the fish and sidetrack immediately. These decisions are based on the overall drilling economics, taking into account the total operational cost versus the cost of the tools left in the hole.

In many drilling applications the risk and economics associated with open hole fishing dictates that alternate methods should be evaluated to re-establish drilling operations. Methods currently available include setting a cement plug or using a whipstock to detour around the fish. Setting a cement plug has been the method of choice over the years due to risk, technology, and ease of installation. However, advances in cased hole

sidetracking and peripheral equipment, coupled with more complex wellbore geometries, have impacted open hole sidetracking applications to the point where risk is minimal, installation is easy, and it is often times more economical and faster to set a whipstock than setting a cement plug.¹

Cement Plugs

The traditional method of setting a cement plug can be time consuming, economically prohibitive, and/or unsuccessful in sidetracking around a fish. Instances where cement plugs may not be a good alternative to getting around a fish are when either the wellbore is highly deviated, in smaller diameter open hole sections, deep open hole sections, high temperature and/or high pressure intervals, or where there are depth constraints above the kickoff point. At deeper depths with higher temperature and pressures, cement plugs rarely strengthen more than the surrounding formation. This makes it difficult to use the cement plug as a platform to kickoff from. In highly deviated wellbores, cement plugs do not often stay together. Without the strength of a good cement plug, sidetracking around the stuck fish can be difficult. Often cement plugs will have to be placed multiple times to obtain the desired results. This is time consuming and costly.

Open Hole Whipstock Options

Using a whipstock versus a cement plug has become a successful and economical alternative. The challenge in using a whipstock is anchoring it in open hole to effectively sidetrack the well. There have been five methods developed to accomplish this.

1. Latch fish with an overshot.
2. Screw into fish.
3. Set a cased hole anchor inside fish.
4. Open hole packer.
5. Cement a whipstock in place.

The anchoring device that is selected will depend on the circumstances and objectives within the wellbore.

Overshot System: If a fishing neck is left looking up then it is possible to anchor to that fish using an overshot. In this application a double bowl overshot with a left hand and a right hand grapple is required to prevent rotation of the system once it is engaged.

The overshot is run directly below the whipstock and the whipstock can then be run in the hole attached to a mill or a running tool. For directional verification a Mule Shoe or UBHO (Universal Bottom Hole Orientation) Sub is run above the whipstock. (Figure 1). If orienting the whipstock, prior to reaching the fish, orientation of the whipstock face is determined. The workstring is then rotated to the right until the whipstock face is pointed to the desired kickoff direction. Slacking off on the work string and engaging the overshot secures the whipstock in that position. Pulling tension on the work string will release the mill or running tool from the whipstock. If a mill is run, the rathole for the next bottom hole assembly can be drilled.² If deployed on a running tool, the running tool is pulled from the well and a milling assembly is run to drill the rathole.

Jobs where this system is utilized have proven to be a technical and economic success. Time and money were saved by not having to trip in and fish the bottom hole assembly. In each instance the operation took less time than setting a cement plug, with the advantage of having a positive deflection around the fish.

Screw-In Whipstock: In a typical drilling operation when the drilling assembly becomes stuck, a freepoint indicator is run to determine where the drill string is stuck. When this point is determined, a connection above that will be backed off, so that portion of the drill string can be retrieved from the well. If the bottom hole assembly is to be fished, a fishing assembly will be run at this point. It is possible to deploy a whipstock at this time instead of fishing. By placing a screw-in sub on the bottom of the whipstock, the fish can be sidetracked around.

With a competent box looking up from the fish, a corresponding pin is run off the bottom of the whipstock. To withstand the makeup torque of the connection, the whipstock is run on a running tool rather than being run on a mill (Figure 2). This allows a high torque to be transmitted through the whipstock into the connection below, ensuring the assembly is anchored sufficiently to sidetrack. At depth, the whipstock assembly with the pin connection down is screwed into the box connection looking up and made up to a desired torque based on the connection size and type or as operationally permitted. The whipstock running tool is then sheared from the whipstock by placing a pre-determined tensile

value on the workstring, at which time it is removed from the well and a milling assembly is run to drill the rathole for the subsequent drilling assembly.

In areas where this system has been utilized, a 100% economic and technical success has been realized. Correlation's between cement plugs and screw-in whipstock systems have revealed that the costs in using the cement plugs to sidetrack are 40-76% higher. The jobs have been run at depths varying from 12,500 ft. to over 22,000 ft. in open hole sizes ranging from 5-7/8" to 8-1/2". Sidetrack distances have varied from 546 ft. to over 2,600 ft.

Screw-In Whipstock with Directional Control

The obvious limitation to the screw-in whipstock system is the inability to dictate the sidetrack direction. Jobs performed with the screw-in whipstock were limited to wells where drilling direction was not a concern. With this limitation in mind, a downhole orienting swivel was developed. This allows the system to be screwed into the fish to the desired torque, and then by disengaging the downhole orienting swivel via pressure in the workstring, the whipstock face can be turned to the desired kickoff direction using MWD or UBHO sub. Once the desired kickoff direction has been reached, the downhole orienting swivel is re-engaged by bleeding the pressure off, and the system is rotationally locked. Torquing the workstring to the right verifies the tool has functioned properly if no movement is noted.

In February 1998 the first screw-in system with orienting capabilities was run. The whipstock assembly, consisting of the pin connection on bottom, the downhole orienting swivel, and the whipstock were made up to the running tool. Above the running tool a UBHO Sub was run in alignment with the whipstock face (Figure 3). At depth, the fish was tagged and the pin screwed into the box connection looking up. A torque of 12,500 ft-lbs. was placed on the system to make up the connection. With the connection made up, the whipstock face was oriented to the desired drilling direction by disengaging the downhole orienting swivel and reading the whipstock face with a surface read out gyro. When the whipstock face was in alignment, the downhole orienting swivel was locked in place. To ensure everything was in its proper position 4,000 ft-lbs. of torque was placed on the system. After disengaging the running tool from the system, the workstring was pulled from the well. A milling assembly was then run in the hole where 25 feet of rathole was then drilled. Upon completing the rathole, the workstring was pulled and the drilling assembly was run in the hole to continue drilling operations.

Cased Hole Anchor: The cased hole anchor may be

run when the fish has a sufficiently clean and large ID to anchor into. Situations for this application would include when cutting and pulling below a casing shoe, a stuck liner that has been backed off, or a liner that has been pilot milled. There are several options of anchors that can be run, either mechanical or hydraulic. In most cases it is best to run a hydraulic set anchor. Mechanical set anchors require a false bottom to initiate setting, so a bridge plug would need to be placed in the ID of the fish. Running the bridge plug would have to be done on drill pipe, requiring an extra trip in the hole and getting into the fish with a tight tolerance mechanical set device can be a risky proposition. There is also the risk associated in running the mechanical set whipstock in the hole, which can set by hanging on a ledge or the top of the fish. Either case can result in failure to sidetrack the well effectively. For this reason it is best to run a hydraulic set whipstock where the setting of the anchor can be controlled. (Figure 3)

Open Hole Packer: In some cases the fish that is left in the hole will not provide the stability needed for sidetracking. When anchoring is attempted there is nothing to anchor to other than the borehole. Alternative systems must be evaluated in these instances. This typically precludes any mechanical devices, such as hookwall packers or hangers, since their expansion range is limited and the open hole does not provide the uniform surface required for anchoring. An inflatable packer is the best choice in this instance. The specific packers utilized in sidetracking applications should be designed to withstand the torque seen during a window milling operation, yet maintain their integrity when set in a non-uniform hole section.³

Based on the particular application, the packer may be deployed in the hole with or without the whipstock. If the hole above the setting depth is tortuous then the application would dictate running the packer without the whipstock. In more uniform hole curvatures, referring to dog legs up to 15 degrees per 100ft., then the whipstock can be run with the packer. (Figure 4) This is only a rule of thumb and will vary operationally from area to area.

Applications for running this system are open hole where there is a limited area to kickoff, such as if the fish is just below the casing shoe above, where there are restrictions in the wellbore above the kickoff point, where the kickoff point is not just above the fish or bottom of the hole, and where access to the original bore is required after setting, as in a level 1 multilateral.⁴

Cemented Whipstock: The cemented whipstock is reserved for circumstances where there is no fish to provide anchoring and the kickoff point is near the

bottom of the hole with no barriers above to interfere with drilling, such as a casing shoe or trouble zones. The reason for concern uphole is the length of the cemented whipstock system. This is greater than other system due to the necessity of running tailpipe below the whipstock in order provide anchoring once cement has set up. The actual kickoff point is displaced uphole the length of the tailpipe.

To run the system, the whipstock and tailpipe assembly are picked up and attached to the running tool. An inner string is run through the whipstock assembly to provide a circulation path for the cement. The system is run to depth where a cement plug is pumped around the assembly and the running tool is pulled from the well. (Figure 5) A drilling assembly is then run and the well is sidetracked.

Milling Options

Equally important as anchoring the whipstock in open hole sidetracks, is the mill used to drill off the whipstock and around the fish. In soft to medium formation a standard carbide mill will often suffice. However, most of the time when sidetracking alternatives to cement plugs are being evaluated, the formations are medium-hard to hard and may be abrasive. These cases eliminate the standard carbide mills, even hybrid carbide inserts, as an effective alternative to milling the rathole required for the next drilling assembly.

In the 1970's the diamond speed mill was developed for casing exits where the kickoff point was adjacent to harder and or abrasive formations. This development proved successful for the application and is still utilized today in some areas for open hole sidetracking and for hard rock casing exits.⁵

In the 1990's development began on materials for cutting structures that exhibited the benefits of carbide for milling steel, and the benefits of Polycrystalline Diamonds (PCD), for drilling formation. This bridged the gap between diamond and carbide for applications in harder formations and provided an alternative to diamond speed mills. Over the last two years, mills dressed with inserts of PCD have exceeded the performance of diamond speed mills in open hole sidetracking and hard formation casing exits.⁶

Conclusions

Inevitably problems will occur when drilling. Through new innovation, the options now available to address these problems have expanded to include alternatives to setting a cement plug. Five systems have evolved through field operations. Three of these methods use the stuck fish as the anchoring device and two systems must

be set above the fish.

Utilizing the stuck fish as the anchor for a whipstock has proven 100% successful in sidetracking around the fish and re-establishing drilling operations. In addition to being mechanically sound, these systems have proven economically viable compared to the alternatives of fishing or setting a cement plug, especially when compared directly using the same operating criteria. These direct comparisons have yielded substantial cost savings.

A better understanding of the new options and systems available will allow drilling operations to be expedited more rapidly.

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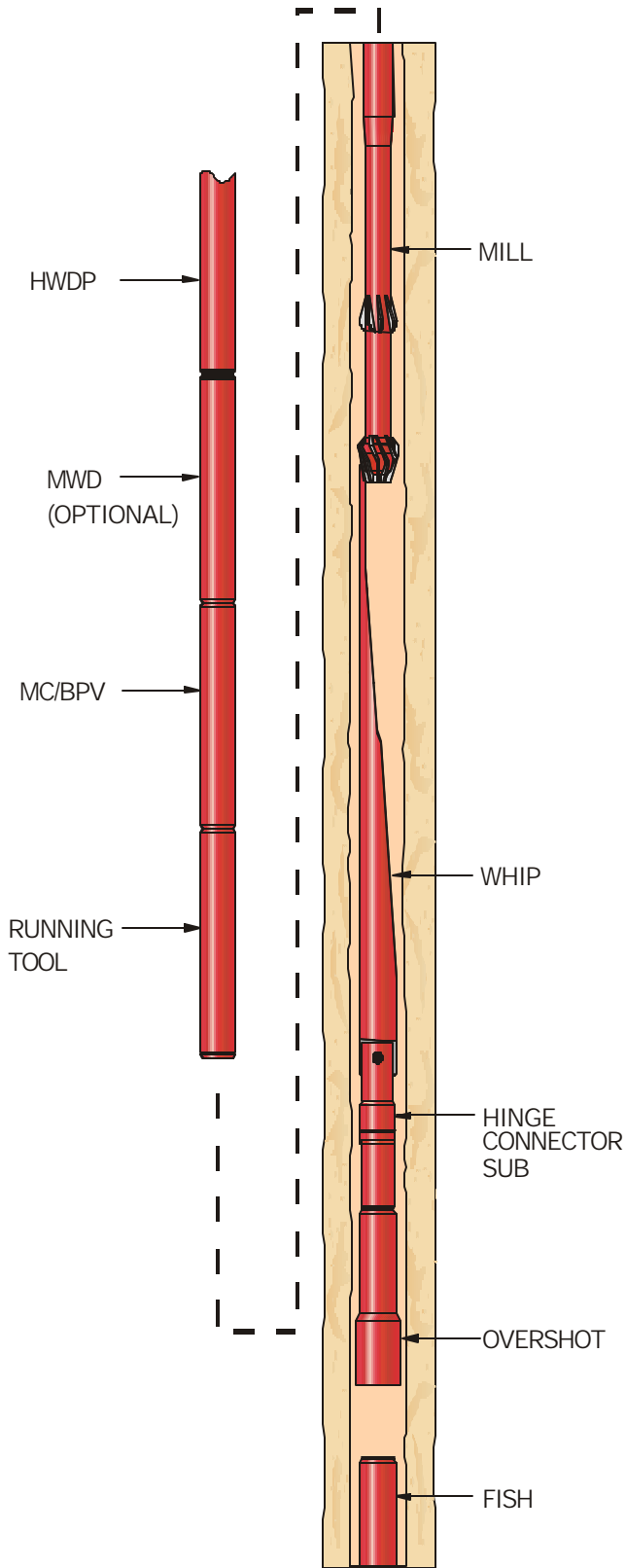


Figure 1 - Overshot Whipstock System

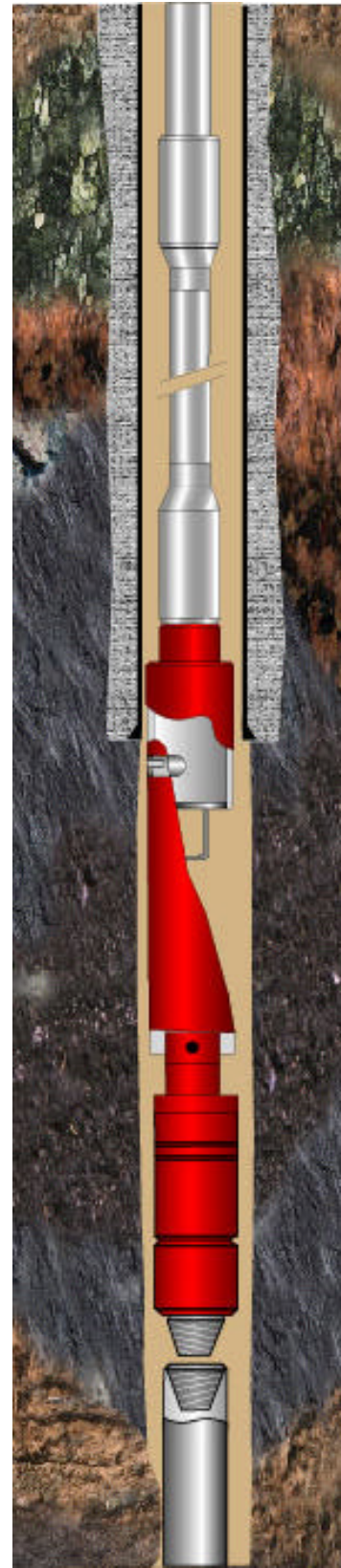


Figure 2 - Screw-In Whipstock System

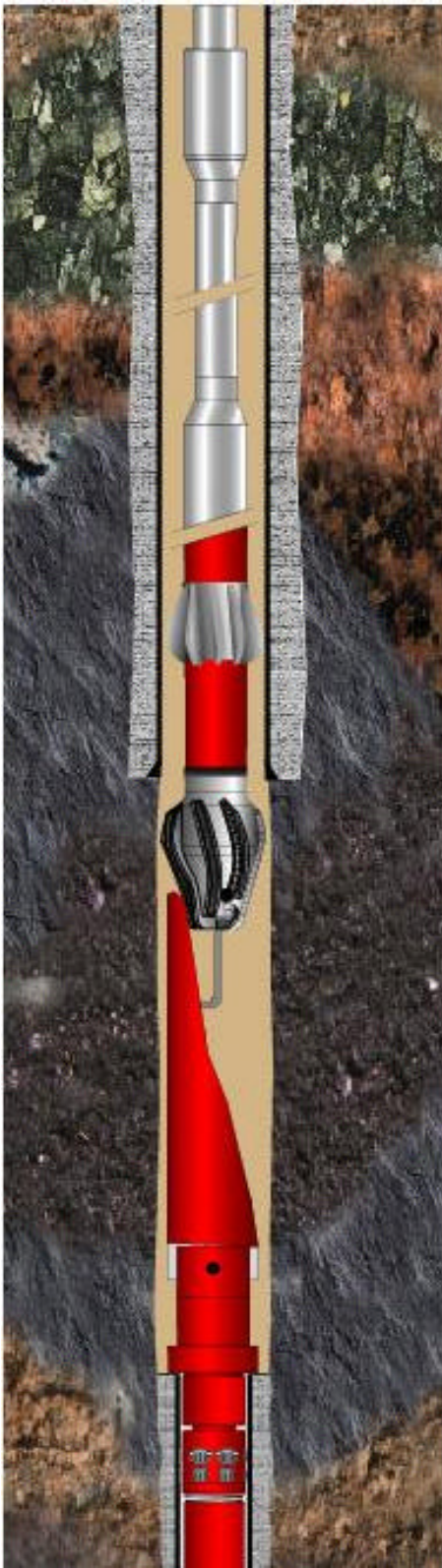


Figure 3 – Cased Hole Anchor System

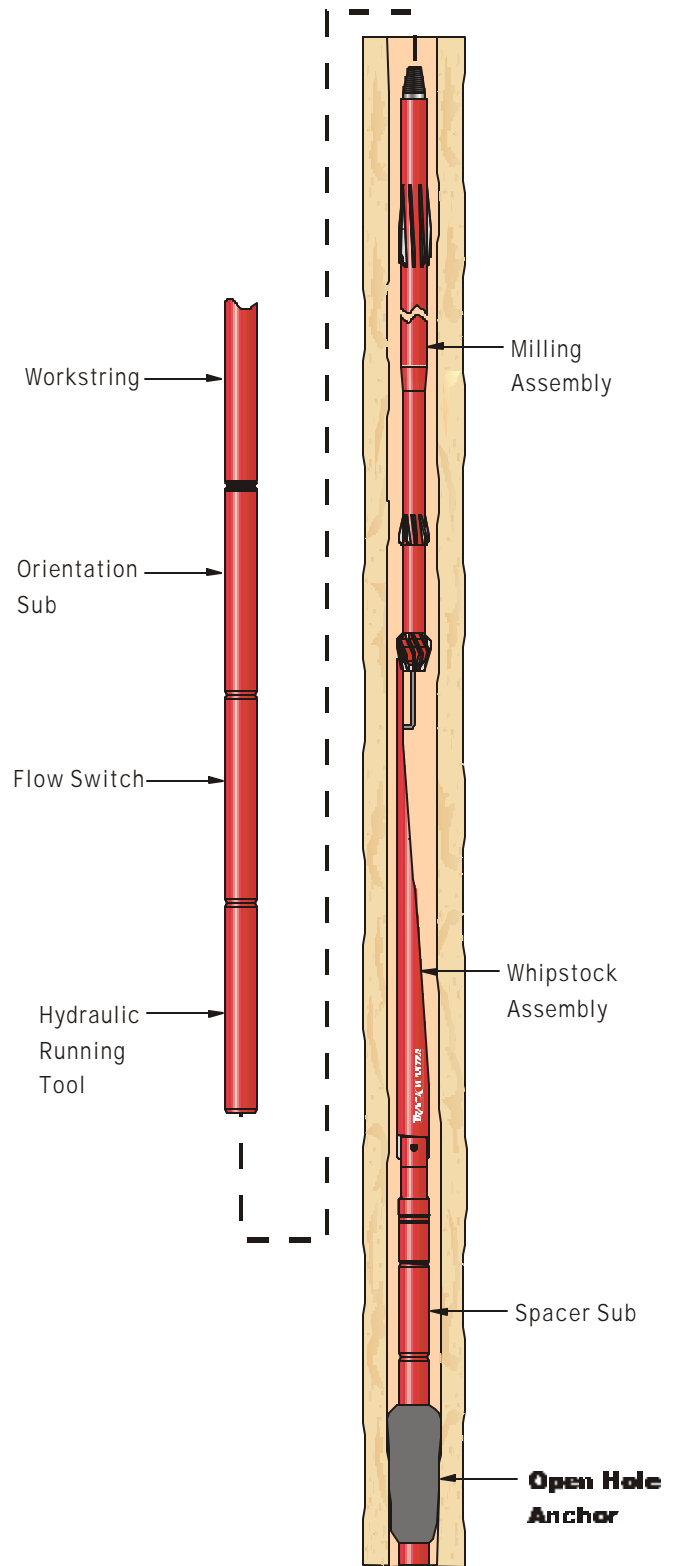


Figure 4 – Inflatable Anchor System

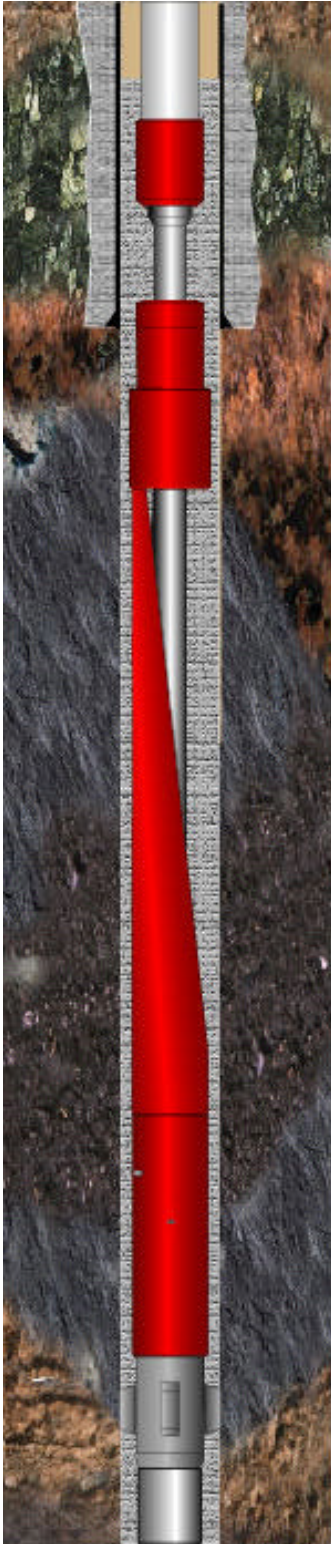


Figure 5 - Cemented Whipstock System