FACILITATING FISHING OPERATIONS IN THE PERMIAN BASIN: PUMP CATCHER

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ABSTRACT
One of the most expensive issues while workover operations are fishing and sometimes it ended up being a non-successful operation when the fish is left in the hole. The time expended trying to pull a fish in horizontal wells is particularly long and the costs are high. Proper planning and good practices should reduce the risk associated with this problem but as a contingency, a new tool has been incorporated in more than 150 installations in the Midland and Delaware basin during 2022. The tool was installed below the weakest point of the BHA or at the end of the tubing and its purpose is to catch the BHA at the TOL avoiding the fish to land in the curve or horizontal section of the wellbore. Once, the fish is maintained above the top of the liner and at the same time allows fluid flow around it, the fishing becomes an easier operation. Two case studies in the same field are presented where one well was installed with this new catcher and the fish was recovered in 3 days. On the other hand, the second well did not have a catcher and the company expended more than two months trying to pull the fish and at the end they couldn't recover it. This well had expenses of more than 1 million dollars without counting equipment expenses.

INTRODUCTION

The oil and gas industry has seen a significant increase in the drilling of horizontal wells in recent years, particularly in the Permian Basin. While horizontal wells offer numerous advantages, such as increased production rates and greater access to reserves, they also pose unique challenges when it comes to maintaining or recover equipment at the bottom of the wellbore.

One of the greatest challenges in horizontal wells is preventing bottom hole equipment from falling into the lateral section of the well. When this occurs, expensive fishing operations are required to retrieve the equipment, which can significantly impact both productivity and costs.

To address this challenge, a revolutionary new tool has been developed for preventing equipment loss in horizontal wells. This tool is specifically designed to keep the bottom hole equipment above the top of the liner or in the vertical section of the well, eliminating the risk of it falling into the lateral section. In addition to preventing equipment loss, the tool also offers numerous benefits, including high cross-sectional area for production fluid, flow area in its body to kill the well after the tool seats on top of the liner, improved safety, and reduced costs associated with fishing operations.

This paper explains the mechanism used by this tool and the different designs deploy based on the wellbore design and the pump depth.

DESIGN AND SIZES

The No-Go catcher figure 1. is made of 1018 and 4140 Steel with maximum OD ranging from 4.3” OD to 6” OD. The oversized section is about 6” long and has built in flow channels (figure 1). to allow operations such as backflushing underneath the tool, avoid debris build up above the tool, and prevent pressure build up by blocking the reservoir below the tool. The tool is incorporated with a 12” neck section that will allow to have sufficient length to catch with an overshot if the BHA were to part above it. The neck section is 2-7/8” tubing with 2-7/8” EUE threads.

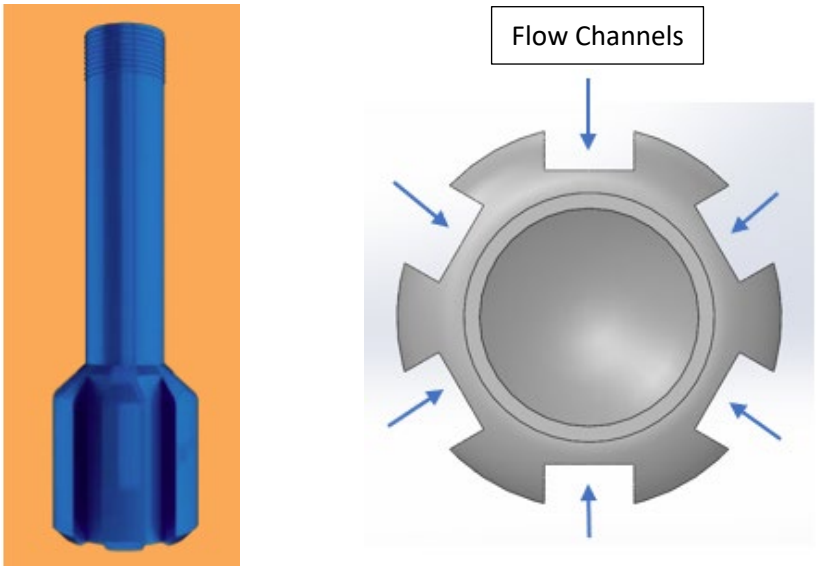

Figure 1. ESP No-Go Catcher

The No- Go catcher has 2 different designs, one that is hollow (figure 1) and has a 2-7/8” EUE threads on the internal part of the oversized section and the other that is solid which is call the No-Go Bull Plug figure 2. Both these designs have their own advantages which is explained later in this paper.

Figure 2 No-Go Models

One of the main design criteria are the flow channels that were built in the No-Go Catcher which allows maximum fluid flow around the tool during normal pump operations. Figure 3. shows the annular flow area we will have with the different models versus the casing ID. With 4.3” OD No-Go Catcher in a 5.5” 20# casing i.e. 6.296 in^2. The annular flow area with the 4.5” OD No-Go Catcher in a 5.5” 20# casing, i.e. 4.902 in^2. On the same way, the annular flow area with the 5.5” OD ESP No-Go Catcher in a 7” 32# casing i.e. 11.847 in^2 and finally, the annular flow area with the 6” OD ESP No-Go Catcher in a 7” 32# casing. Table 1 summarizes the most important specifications of the different models.

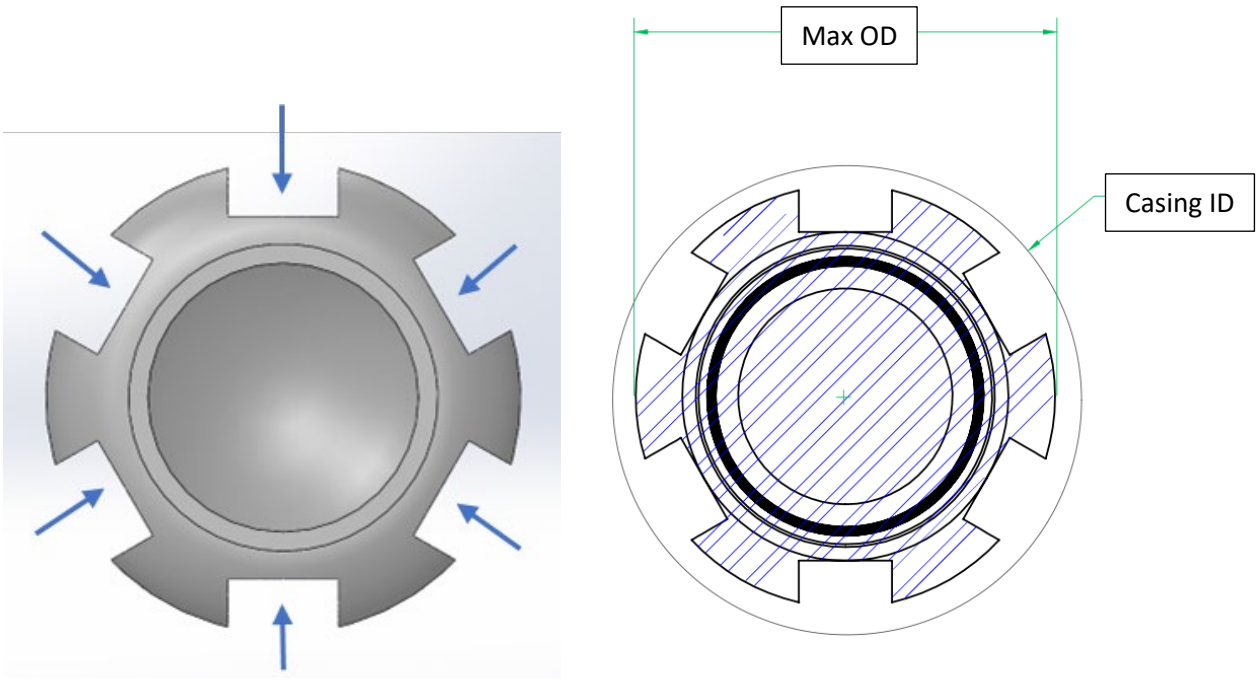

Figure 3 No-Go Cross-Sectional Area

Table 2 No-Go specifications

MODEL	MAX. OD (in)	CASIGN SIZE	FLOW ANNULAR AREA
4.3” NO-GO	4.300	≥ 5-1/2” 20#	6.296 in^2
4-1/2” NO-GO	4.500	≥ 5-1/2” 20#	4.902 in^2
5-1/2” NO-GO	5.500	≥ 7” 32#	11.847 in^2
6” NO-GO	6.000	≥ 7-5/8” 39#	12.623 in^2

FIELD DEPLOYMENT AND OPERATION

To increase rates on frac jobs given the friction imposed by 5.5" production casing or smaller, many operators in the Permian basin as of late 2019 keep the 5.5" production casing in the lateral and curve, but around the kickoff point cross over to 7" casing or

similar sizes to surface. The No-Go Catcher is developed for wells that crosses over either from 7”, 7-5/8” to 5-1/2” or 5-1/2” to 4-1/2” or 5”. The 2 designs mentioned earlier, the hollow and solid, can be selected based on the application where the hollow design is used when operators like to get the ESP closer to the KOP where typically the liner hangar or casing changeover is which allows to have tail pipes inside the liner section so tail pipes can be installed below the hollow No-Go catcher figure 4. And the solid design can be used if the operator just wants to replace the bull plug as shown in figure 5.

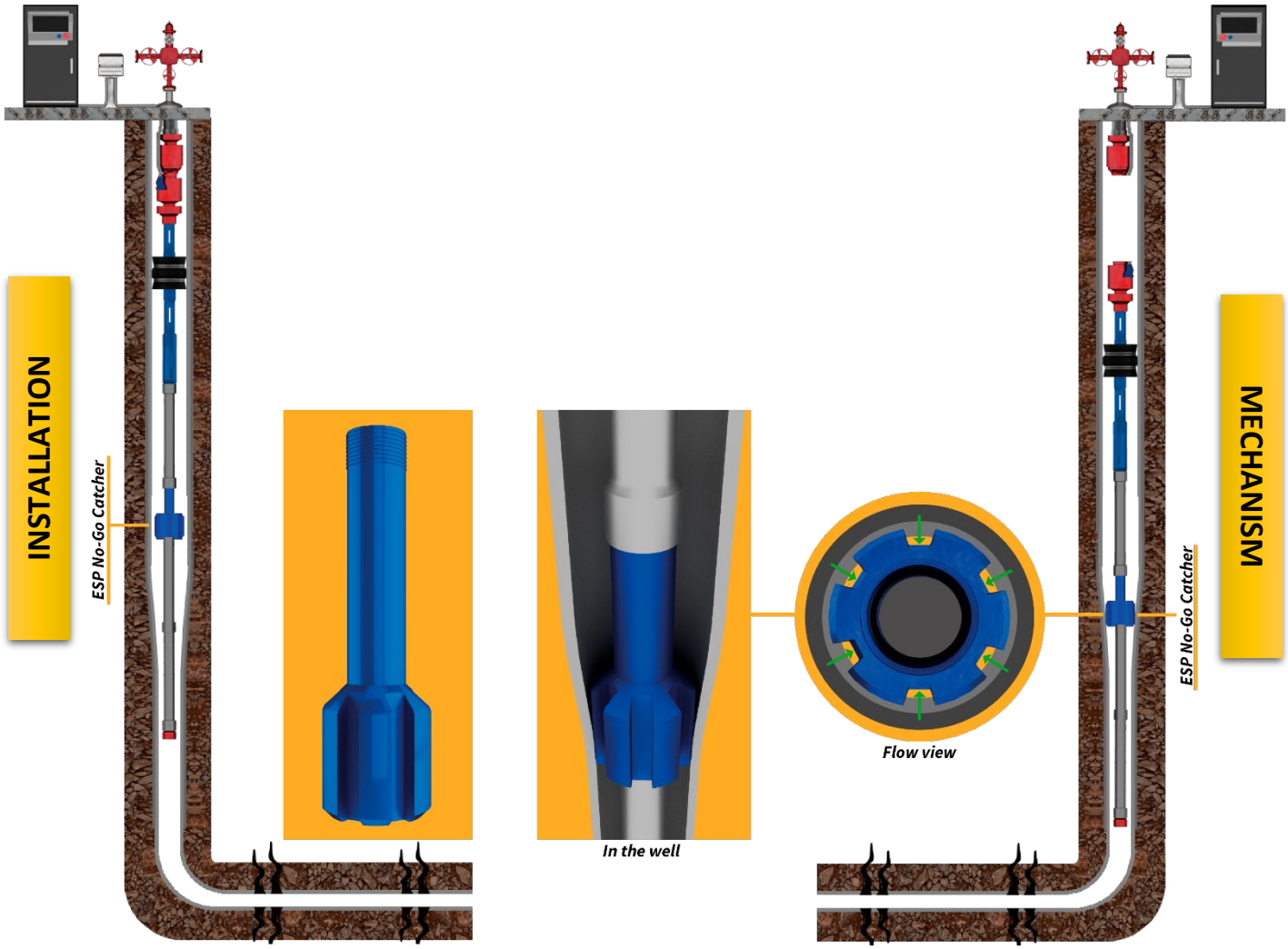

Figure 4 No-Go Installation and Operation

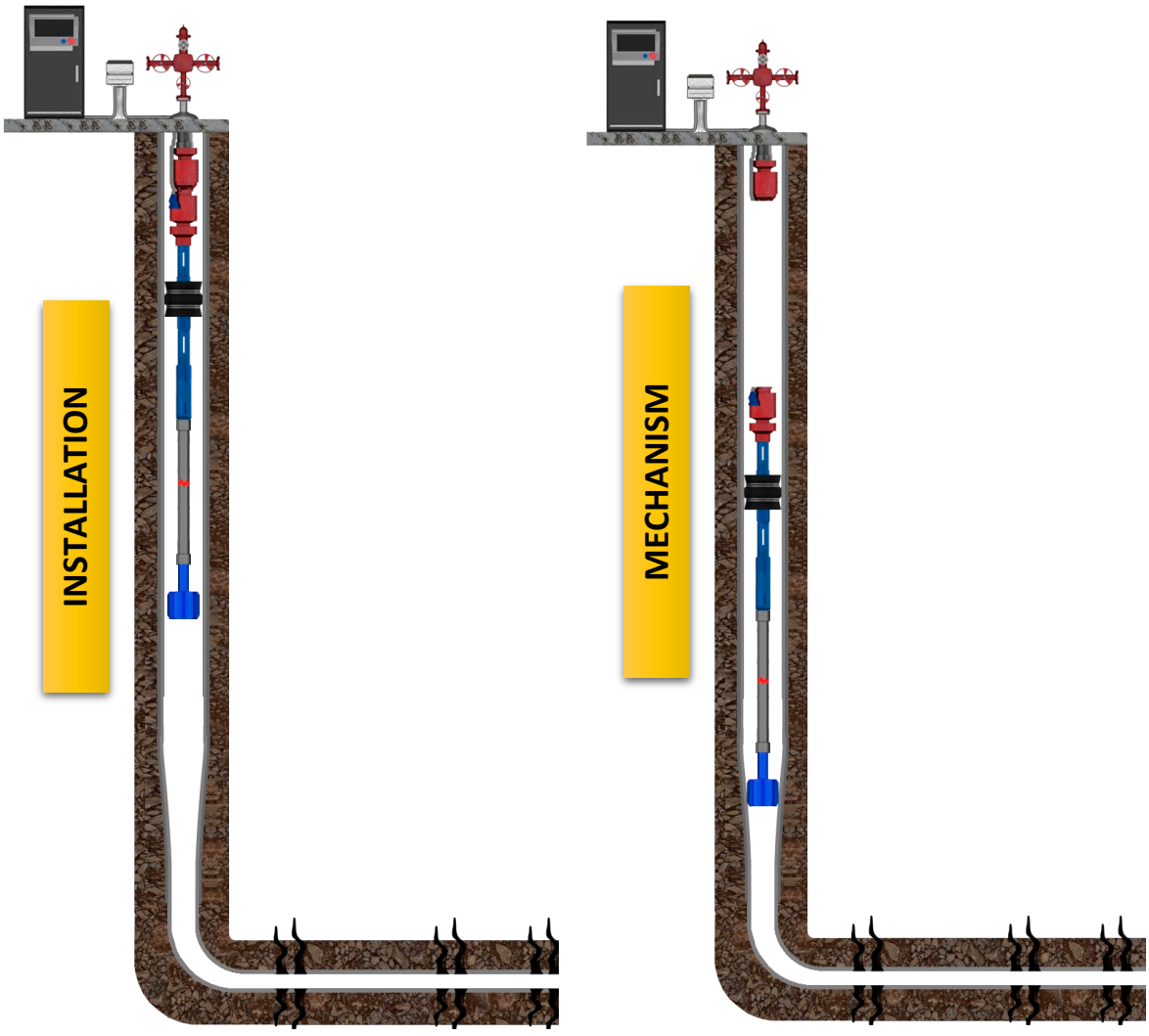

Figure 5 No-Go Bull Plug Installation and Operation

There are multiple ways to deploy the No-Go Catchers, if the operator has no Desander, BHA below the ESP then the No-Go catcher which is solid from the bottom can be threaded directly to the ESP sensor using a 2-3/8” changeover. With the Desander, the No-Catcher can be threaded either directly to the first tail pipe that goes downhole replacing the bull plug or, between other mud joints in cases where previously mentioned mud joints land inside the liner section.

Wells that are not completed using 2 different casing typically have ESP catch packers installed before going in with an ESP. In cases where there are such packers, operators have had issues with fishing jobs where tailpipes or ESP sensor gets stuck when impacted with the catch packer that could lead to issues where fishing the equipment become an expensive operation. In such cases the Solid ESP No-go catcher is installed at EOT to avoid stuck equipment as shown in figure 6.

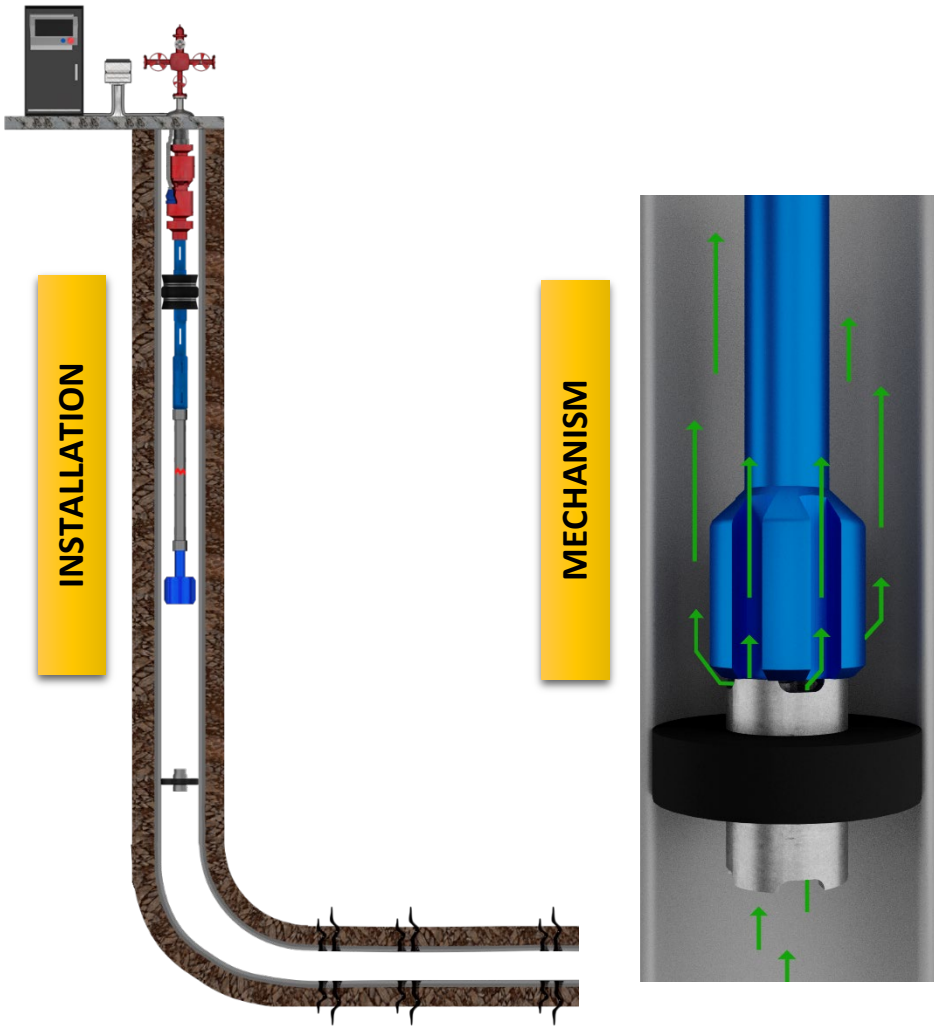

Figure 6 No Go Installation and Operation in Straight Casing

FIELD STUDY

As of March 2023, there has been over 650 wells in the Permian Basin with No-Go catchers and No-go Bull Plugs installed below ESPs. 50% of those installations have been the 5.5” No Go catchers deployed in 7” Casing with 5-1/2” changeover casing at KOP spread equally across Midland and Delaware basin. 35% have been 4.5” No Go catcher Bull Plugs in wells with 5” or 4-1/2” Liner as well as ESP catch packers. About 10% have been 4.3” No go catchers in similar wells with 5” or 4-1/2” liner as well as ESP catch packers. And about 5% have been the 6” ESP No-Go Catchers.

CASE STUDIES

Two case studies in the same field are presented where one well was installed with this new catcher and the fish was recovered in 3 days. On the other hand, the second well did not have a catcher and the company expended more than two months trying to pull

the fish and at the end they couldn't recover it. This well had expenses of more than 1 million dollars without counting equipment expenses.

Starting in late March 2022, all new ESP installs in Midland Basin have an "No-Go Catcher" below ESPs. Results have already been observed, in well A the ESP pump housing parted June 21st when the well was making 600 BOPD/1600 MCFD. The "ESP No-Go Catcher", which was installed on April 13th, caught the ESP, and allowed for successful fishing of the pump stages and remaining BHA, with the second ESP reinstalled June 24th and all prior production returned. On well B, which did not have a ESP No-Go Catcher parted in May of 2022 on the 10th and the operator started fishing immediately. The well was making 750 BOPD/1800 MCFD It took over 2 months and as of July 15th they were not able to fish out the equipment, spending over 1 million dollars and finally decided to push it to the end of the lateral section to start the production back. Well B not only lost over a Million dollars in fishing operation but also lost over 2 months of production. Refer to figure 7 and figure 8.

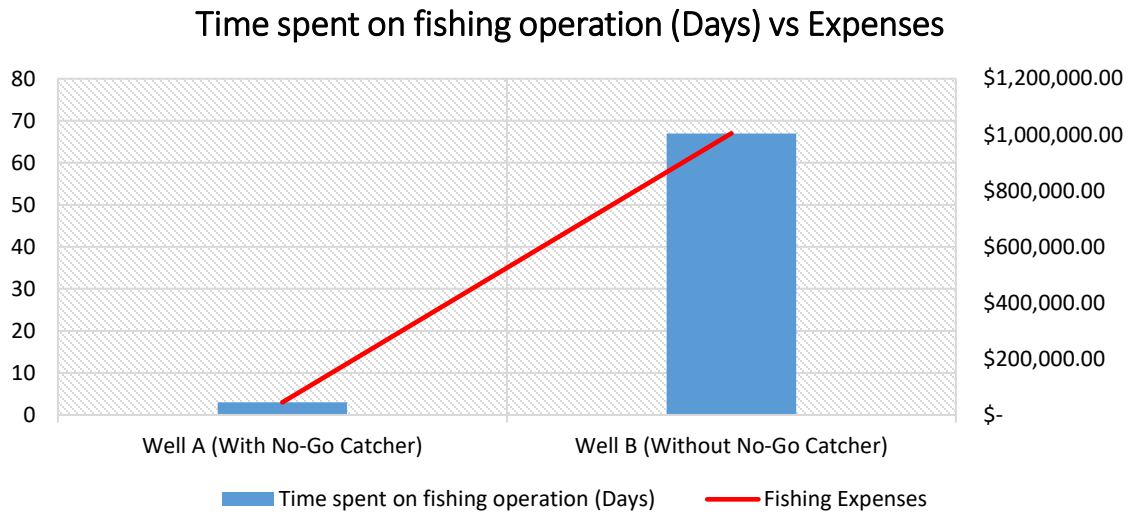

Figure 7 Fishing time and expenses Well A and Well B

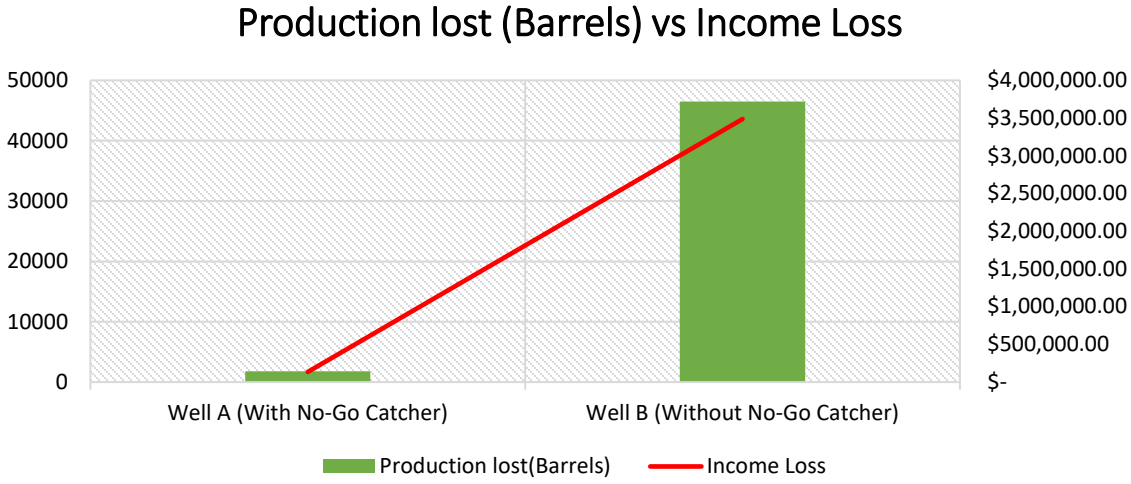

Figure 8 Production lost and income loss Well A and B

The "No-Go Catcher" is not limited to ESPs, but it has been applied in rod pump wells with potentially difficult to fish BHAs in Midland Basin as well.

CONCLUSION

- The new tool designed for preventing equipment loss in horizontal wells has significantly reduced the need for expensive fishing operations. By keeping the bottom hole equipment above the top of the liner or in the vertical section of the well, the risk of equipment falling into the lateral section is eliminated, resulting in reduced costs associated with fishing jobs.
- The tool can save not only millions on fishing operation but also minimize production loss.
- The Built in flow channels in the No Go catcher allows the well to be killed for fishing operations.
- In cases where there is ESP catch packers, the No-Go catchers makes sure the ESP equipment and components are not stuck in the packer.
- The use of No-Go catchers is an inexpensive way to ensure smooth fishing operations.
- With the increasing number of horizontal wells being drilled in the Permian Basin and the recent trend towards tapered casing designs, the introduction of this new tool is timely and highly beneficial for the industry. It offers numerous advantages, including improved safety, reduced costs, and increased productivity, making it a game-changing solution for maintaining bottom hole equipment in horizontal wells.

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