Wellbore Integrity
SOLUTIONS

RED BARON

PERFORMANCE BULLETIN PORTFOLIO

A History of Innovation.
Unrivaled Experience.
Global Presence.

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ASIA PACIFIC

ProLATCH System and TruEdge* Inserts: A Solution for Deep-Water Subsea Wellhead Abandonment

Efficiently cut multi-casing and recovered subsea wellhead in a single trip, facilitating plug and abandonment operation offshore Japan.

Wellbore Integrity Solutions (WIS) achieves customers' objectives with successful engineering solutions for deep-water subsea well abandonment.

The customer needed to retrieve two subsea wellheads off the coast of Japan. We proposed using the ProLATCH one trip system to cut the casing and recover the wellheads in a single operation. One significant challenge was performing a dual cut of the 9⅝ inch casing and the 24 inch conductor simultaneously. The 9⅝ inch casing was cemented back to the surface, making it impossible to remove the inner casing separately. Additionally, conducting this operation in open water added further complexity to the pipe-cutting process.

Wellhead and casing conductor retrieved with the ProLATCH System

During the job planning stage, WIS engineered a new casing-cutting knife to accommodate the longer knife sweep and integrated TrueEdge inserts technology. The job planning process also included detailed operation parameters, hydraulic analysis for the pipe cutter with the custom knives design, BHA centralization and detailed running procedure.

New design arm set with TrueEdge Technology

Leveraging our skilled personnel, WIS successfully executed this challenging operation to cut the concentric multi-casing string of 9⅝ inch x 24 inch casing in a single run. The ProLATCH system flawlessly landed on the subsea wellhead, executing the dual-cutting operation while maintaining tension on the surface. Both the casings and the wellhead were then recovered in record time.

9⅝ inch casing x 24 inch conductor cut

CHALLENGE

A customer in Japan needed to recover subsea wellheads in a deep-water setting. The challenge was to accomplish a dual cut of the 9⅝ inch x 24 inch casing configuration in a single run. However, existing tools couldn't fulfill this objective due to the non-standard casing configuration.

SOLUTION

The ProLATCH system was suggested and set up with newly engineered knife designs. These pipe cutter knives were specifically crafted to deliver an extended sweep, ensuring the necessary cutting forces could be applied. Additionally, the design was enhanced with TrueEdge* inserts to optimize cutting time and operational efficiency. Detailed hydraulic simulations were conducted to evaluate the performance of the new knife design, including the added knife tip force.

RESULTS

- Accomplished the demanding task of cutting the multi-string 9⅝ inch x 24 inch casing.
- Utilized the ProLATCH system for cutting and recovering the casings.
- Newly designed TrueEdge knives met and exceeded customer expectations.
- This innovative solution facilitated the retrieval of the subsea wellhead and multi-casing string (9⅝ x 24 inch) in a single trip.

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An Outstanding Pilot Milling Performance in Brunei Results in > $2M in Cost Savings

A step change in total meterage milled and a ROP improvement of 182% compared to offset data was achieved. The operational rig time was reduced by 9½ days.

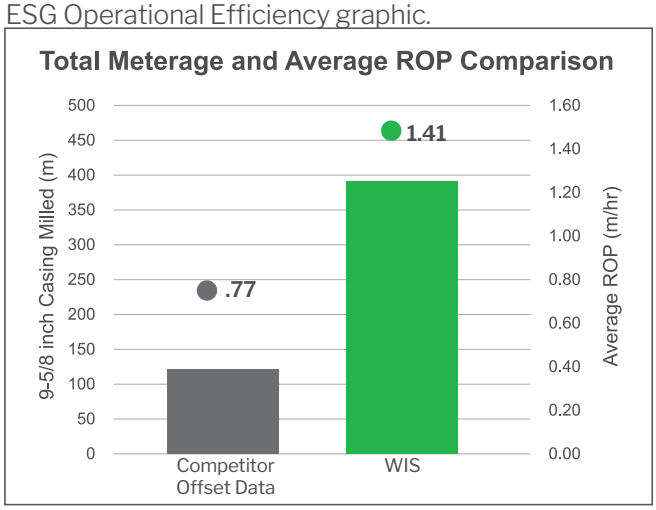
Photos 1-3 show the mill wear after the pilot milling run.

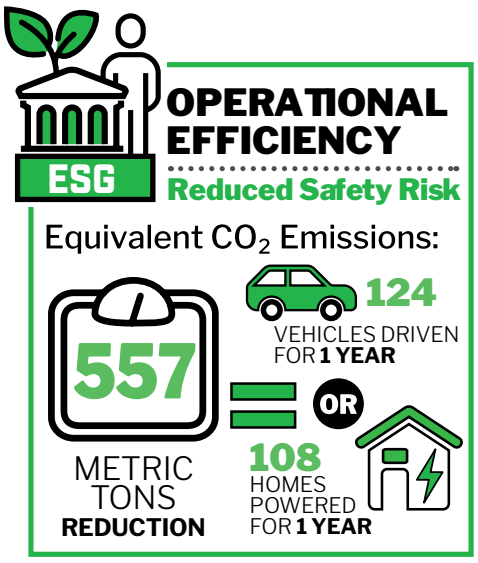
An optimization of milling performance demonstrated.

The Wellbore Integrity Solutions (WIS) Red Baron team supported the customer effectively in the abandonment of two wells. Pilot milling performance was highlighted as a key success in both wells, with a step-change in results when compared to competitor offset data. Operational planning, proven procedures and a robust risk assessment all contributed to the results:

- Mitigation of risks while milling uncemented casing.
- BHA design optimization to improve dynamic behavior and increase milling ROP. An average milling ROP of 1.4 m/hour was achieved.
- Milling parameter optimization.

In addition to the significant time and rig cost savings realized, the corresponding emissions reduction was also considerable, as illustrated in ESG Operational Efficiency graphic.





CHALLENGE

A customer in Brunei required a total of 389m of 9⅝ inch casing to be milled in two wells. Uncemented casing increased the milling operational risk.

SOLUTION

- Rigorous planning, procedures and risk assessment.
- An optimized pilot milling BHA design with Red Baron pilot milling technology.

RESULTS

- A successful milling operation with no non-productive time (NPT).
- An improvement of 182% in overall ROP.
- A rig time reduction of 9 ½ days and a cost savings for the customer of > $2M.
- Significant reductions in emissions generated.

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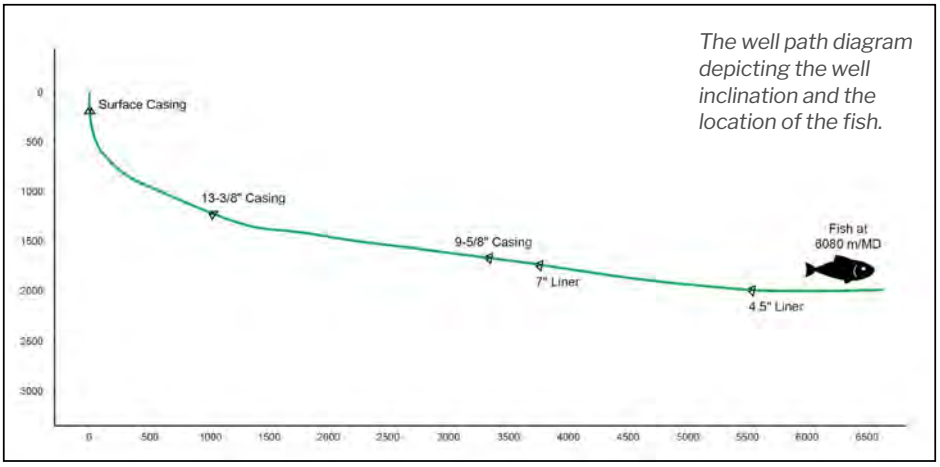
An Outstanding Fishing Performance Completed for Hibiscus Malaysia Limited

Successful retrieval of a parted 4.5 inch liner hanger running tool, in a deep horizontal well on the first attempt.

A high angle, deep, horizontal fishing operation presented unique challenges.

Hibiscus needed to retrieve a 4.5 inch liner hanger running tool in a deep horizontal well. After planning and discussions, Wellbore Integrity Solutions' (WIS) Red Baron team proposed the fabrication of a 3⅞ inch Bulldog Overshot to recover 660m of fish in a 6963m deep well in one run. The 4.5 inch liner hanger running tool was stuck and lost in the hole, and because of the irregular dimensions, conventional fishing tools could not be used to retrieve it.



The well path diagram depicting the well inclination and the location of the fish.

The recovered fish pulled up through the rotary table.

CHALLENGE

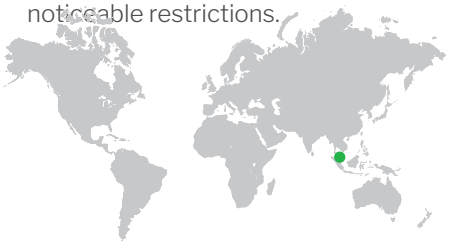
- To fish a 4.5 inch liner hanger running tool in a horizontal well at a depth of 6080m.
- Fabricating a high tensile overshot tool, appropriately sized to retrieve the fish with irregular dimensions.
- Perform fishing operations in a well with very tight tolerances.
- Work within a tight timeline of two weeks to plan and fabricate the required tools.

SOLUTION

- Perform a cleanout run with a 3⅞ inch taper mill and 3⅞ inch watermelon mill inside of the 4.5 inch liner hanger.
- Run a 3⅞ inch Bulldog Overshot to recover the parted liner hanger running tool.

RESULTS

- Successfully retrieved fish on the first attempt enabling the customer to continue with the planned completion with minimal delays.
- Ran the completion string on the subsequent run in the hole with no noticeable restrictions.



Successfully recovered 660m of fish in Malaysia.

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Multi-Lateral Geothermal Sidetrack Success Continues in the Philippines

A geothermal sidetrack campaign for Philippine Geothermal Production Company Inc. (PGPC) demonstrates the value of the TrackMaster* Select system.

Key Solutions for Multilateral geothermal operations.

The close collaboration between Philippine Geothermal Production Company, Inc. and Wellbore Integrity Solutions' Red Baron team continued to deliver operational success with a recent cased hole sidetrack. To ensure success, where high compressive strength rock was found at the exit point along with a risk of lost circulation, the TrackMaster Select System was chosen. The system configuration consisted of a 13 ⅜ X 20 hydraulic anchor, and Tri-mill assembly ensuring a secure anchor of the whipstock occurred and a full-gauge, usable window was provided. Customized procedures and contingency solutions were also developed. After drilling operations ended, the TrackMaster Select system was recovered to re-establish full wellbore access and enable multi-lateral production.

Considerations:

- Achieve a successful exit in 13 ⅜ inch casing at 3336 ft. with a DLS of 2.36deg/100ft. The exit should provide a full gauge, usable window.
- Select the optimum system configuration, including anchor type and mill, suitable for > 27 ksi UCS formation.
- Ensure comprehensive procedures were in place, with contingency options. Evaluate risks associated with loss circulation zones.
- Incorporate Gyro orientation method procedures.
- Ensure that the subsequent 12 ¼ drilling BHA would successfully pass through the window without resistance.
- Recover the TrackMaster System to re-establish wellbore access.

CHALLENGE

- Construct a multilateral geothermal well sidetrack from 13 ⅜ inch casing in a hard rock.
- Ensure retrievablity to provide the required multilateral architecture.

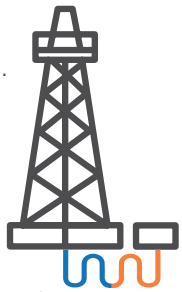
SOLUTION

- A 13 ⅜ inch TrackMaster Select System with a hydraulic set expandable anchor and hybrid Tri-mill assembly.
- Robust operational procedures and a collaborative approach with PGPC.

RESULTS

- Accomplished sidetrack successfully in a hard rock formation.
- The TrackMaster Select System was retrieved after drilling operations to enable multi-lateral production.
- Customer satisfaction that the complex objectives were achieved.

Recovery of the TrackMaster Select System using the retrieval hook.



TrackMaster Select™

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- GLOBAL PRESENCE

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A Dual Casing Exit Success in Indonesia Using the TrackMaster Select*

Superior performance was achieved using the TrackMaster Select System with an Integral Tri-Mill.

Multiple challenges were successfully completed on a difficult project.

The Wellbore Integrity Solutions' (WIS) Red Baron team in Indonesia worked with the customer to identify several factors that could pose potential problems when executing a 9 5/8 inch x 13 3/8 inch dual casing exit in one-trip.

The first TrackMaster Select System with an Integral Tri-Mill application for a dual casing exit 9⅝ inch x 13⅜ inch was successfully run in one single trip in Indonesia.

Challenges to consider:

- Vertical well, < 3 degree inclination
- Soft formation with UCS < 5 Kpsi
- Unknown cement integrity behind the outer casing

After a complete evaluation, the project's best option for success was to use the Trackmaster Select System with an Integral Tri-Mill.

CHALLENGE

The customer approached the WIS Red Baron team to perform a dual casing exit in 9 5/8 inch x 13 3/8 inch casing. The quality of the window and associated risks were assessed. The vertical nature of the well and unknown cement integrity behind the outer casing had to be considered during the milling operations.

SOLUTION

A one-trip TrackMaster Select System with an Integral Tri-Mill was proposed to the customer.

RESULTS

- Successful single trip 9⅝ inch x 13 3/8 inch dual casing exit
- Completed the dual casing exit in one run at controlled ROP and in minimal time (16.5 hours)
- Subsequent directional drilling Bottom Hole Assemblies (BHA) passed the window smoothly with no issues

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The ProLATCH* Subsea P&A System Delivers Superior Performance, Offshore Japan

A successful campaign, utilizing the Wellbore Integrity Solutions (WIS) Pipe Cutter and ProLATCH* System, delivered cutting efficiency and time savings for the customer.

The ProLATCH* System plays an integral part of a successful P&A program.

A combination of expertise and technology offered by WIS in an exploration well P&A delivered outstanding results. The customer reported a significant reduction in cutting time, and the casing(s) and wellhead were recovered successfully to the surface. The use of the ProLATCH* system simplifies both the cutting operation and the recovery of the wellhead. The system consists of a Hydraulic Pipe Cutter, a Non-Rotating Stabilizer, and a Non-Rotating Spear that can be configured to engage the internal profile of the wellhead system. In this example, the use of the system resulted in the recovery of a Drill-Quip SS-10RLD Wellhead in 3 hours and 30 minutes.

Figure 1: Cut 9⅝ inch Casing 53.5ppf

Figure 2: Cut 13⅜ inch Casing 68ppf

Figure 3: Cut 20 inch x 36 inch Casing

Figure 4: ProLATCH with HPWH at MoonPool*


Figure 1


Figure 2


Figure 3


Figure 4

CHALLENGE

Prior to the completion of an offshore exploration well, the customer required WIS to cut and retrieve four strings of casing, including a dual cut of 20 inch x 36 inch with High Pressure Well Head (HPWH). The 20 inch x 36 inch HPWH also required cut and retrieval in a single trip.

SOLUTION

WIS recommended the use of the ProLATCH* system to conduct this P&A program.

RESULTS

- The 9⅝ inch 53.5ppf and 13⅜ inch 68ppf casings were cut in a record time of 3 minutes
- The 20 inch x 36 inch HPWH was cut and recovered efficiently, in a single trip in 3 hours and 30 minutes, faster than planned
- No additional trips were required to cut the casings
- The program was completed successfully, with zero HSE or Service Quality Incidents

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Continued Sidetracking Success in Geothermal Operations Using the Trackmaster Select System

The Trackmaster Select*, configured for Geothermal Operations, successfully completed a 13 ⅜ casing exit in a single trip. After the conclusion of drilling operations, the system was retrieved to enable multilateral production.

A system ideally suited to Geothermal Operations.

A customer in the Philippines required a cased hole sidetrack from 13⅜ casing as part of a multilateral project The known challenges included a high compressive strength rock at the exit point, in addition to, significant expected fluid losses. As part of the planning process, Wellbore Integrity Solutions (WIS) worked closely with the customer to select the best system configuration and operational procedures for this application.

Previous experience had shown that the chosen Trackmaster Select configuration could perform well in such conditions.

- Exit Point in 13⅜ inch casing, 68ppf, at 3820 ft with a DLS of >3deg/100ft.
- Hydraulic set system, including expandable anchor and hybrid tri-mill suitable for high compressive strength formation, >27 ksi.
- Gyro orientation method.
- Rathole length of 21 ft, full gauge diameter.
- System subsequently recovered with Trackmaster hook to re-establish wellbore access.

CHALLENGE

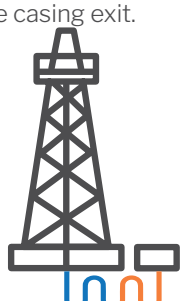
- To construct a multilateral geothermal well, a sidetrack from 13⅜ inch casing was required in a high compressive strength formation (>27ksi).
- Fluid losses were also an additional concern during the sidetracking operation.
- The system also had to be fully retrievable to provide the required multilateral architecture.

SOLUTION

A 13⅜ inch Trackmaster Select System with a hydraulic set expandable anchor and tri-mill assembly was chosen for this Geothermal application. The system selection was both suitable for use in a fluid loss environment and capable of drilling an extended rathole in the high compressive strength formation. A gyro was utilized to orient the system.

RESULTS

- Successful 1-trip sidetrack.
- System operation not impacted by fluid loss environment
- A 21 foot rathole was drilled in a high UCS formation.
- The tri-mill had acceptable wear, confirming a full gauge casing exit.
- The subsequent 12¼ inch drilling BHA passed freely through the window.
- System successfully retrieved with standard retrieval hook.



TrackMaster Select™

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- GLOBAL PRESENCE

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ProMILL Duo* Delivers Record Savings in a Brunei Well Abandonment Application

A permanent well barrier across 7 inch x 9⅝ inch x 13⅜ inch casing was accomplished in record time for the customer, saving $2.5MM and 17 days of rig time.

CHALLENGE

The customer required a 22m long permanent well barrier across three string of casings, 7 inch, 9⅝ inch and 13⅜ inch. Multiple casing centralizers were also present that required to be milled. Maintaining the integrity of the outer 13⅜ inch casing, was also of paramount importance to ensure the integrity of the well barrier.

SOLUTION

WIS recommended and deployed a selection of well abandonment technologies to deliver the solution. This included the 6000 series ProMill Duo to mill 9⅝ inch inside 13⅜ inch. Special ProMill Duo arm sets were utilized to ensure that the ID of the 13⅜ inch casing was free from damage. A new configuration of ProMILL underreamer arm was also utilized to effectively clean cement inside the 13⅜ inch casing.

RESULT

- A successful project execution that saved 17 days of rig time and a cost saving of $2.5MM for the customer.
- Multiple technologies functioned as intended, including the ProMILL Duo, the unique milling structures, the new arm profiles to protect the outer casing ID and the new ProMILL underreamer clean out arms.

ProMILL Duo technology continues to deliver operational success globally.

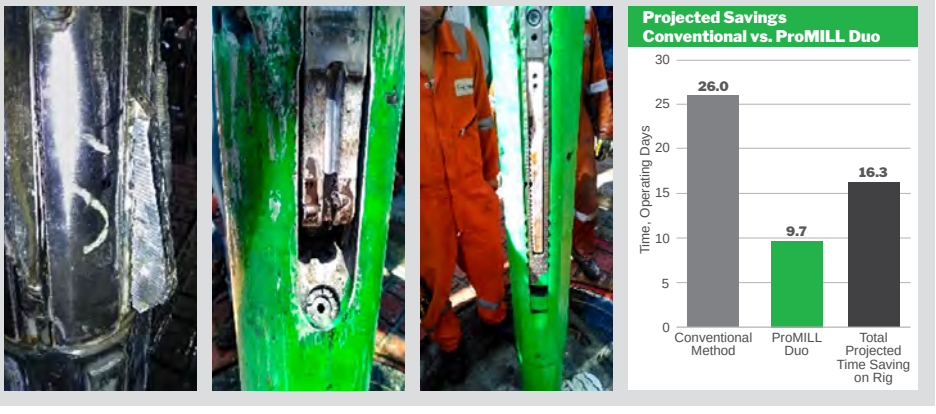
In this example from Brunei, the challenge was to provide a well barrier across three strings of casings without compromising the integrity of the outer casing. This was a deviated well application that also included multiple casing centralizers that had to be milled.

This project was successfully achieved in a record time with proper planning, selection and utilization of WIS technologies.

Highlights:

- The inner, 7 inch 29ppf casing was milled successfully with WIS section milling technology.
- The ProMILL Duo was then deployed to drift through the 7 inch casing and mill the 9⅝ inch, 47lbs/ft casing. A new arm configuration was used to ensure that the outer, 13⅜ inch casing was not damaged.
- The 13⅜ inch casing ID was cleaned out with a new design of arms for the ProMILL Underreamer to assist in the assurance of a high quality cement barrier.

The combination of the robust ProMILL Duo system and experienced WIS Field Personnel resulted a successful project, completed in record time.



Left: Section Mill 5500 Series
Left Center: ProMILL Underreamer 12.191 inch OD post run
Right Center: ProMILL Duo 6000 Series prior to running in hole
Right: Time saving ProMILL Duo comparison vs. conventional method

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Planning and Experience in Geothermal Operations in Indonesia Ensures Success

Two different operational examples highlight specific procedural requirements in geothermal applications.

CHALLENGE

To ensure operational success in geothermal applications, two examples are highlighted that include requirements to operate in a total fluid loss scenario. The second example also includes the additional challenge of milling in a high compressive strength formation.

SOLUTION

In both examples, a combination of thorough planning, customized procedures for geothermal applications, and experienced local personnel were instrumental in ensuring success.

RESULTS

Example 1

- The liner was successfully cut and retrieved while under total fluid losses.
- The customer continued to drill an open hole sidetrack and reach the desired reservoir target.

Example 2

- The cased hole sidetrack into a high compressive strength formation was delivered in one trip using the TrackMaster Select System.
- The well was successfully concluded.

Example 1: Cut and pull a 10¾ inch perforated liner to enable an open hole sidetrack.

As common in many geothermal operations, fluid losses and uncertainty in the annulus versus drillstring pressure regime is a significant challenge. In this particular example, a hydraulically activated pipe cutter was used to successfully cut a 10¾ perforated liner, despite the total fluid loss scenario in the wellbore. The local WIS team worked closely with the customer to tailor a specific operational procedure to ensure hydraulic optimization.

Prior to the deployment of the WIS cutting BHA, a conventional rotary BHA was used to simulate and quantify fluid losses in the wellbore. The cutting BHA was then deployed and successfully cut the liner at the required depth. The liner was subsequently retrieved as planned.

The customer then continued to perform an open hole sidetrack and reach the reservoir target depth.

Example 2: Conduct a successful sidetrack in 13⅜ casing with a high compressive strength formation in a total fluid loss scenario.

In addition to experiencing total fluid losses, this geothermal well required a sidetrack in a high compressive strength formation. For this example, the WIS team also prepared a customized operational procedure to ensure success. Due to uncertainty in the hydraulic flow regime, the TrackMaster Select* System was oriented to the desired position using a gyro to eliminate the risk of prematurely setting the anchor. A tri-mill configuration was also utilized to ensure that both the casing was milled and the rathole drilled in a high compressive strength formation.

The sidetrack was completed successfully in a single trip. The subsequent directional drilling BHA was then deployed to drill ahead as planned.

Both the above examples highlight the importance of planning, customized procedures, and local experience in Geothermal operations.

TrackMaster Select

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TrackMaster Select System Successfully Deployed, Northern Territory, Australia

The WIS team in Australia mobilized a TrackMaster Select system at short notice to complete a hard formation sidetrack in a single trip.

CHALLENGE

A customer required the rapid mobilization of a 9⅝ inch whipstock system to perform a casing exit from 9⅝ inch P-110 casing at a depth of 1199 m. The exit was also characterized to be in a high formation compressive strength zone. After completion of window milling, a 3.3 m rathole was required to enable directional drilling to continue.

SOLUTION

A 9⅝ inch TrackMaster Select whipstock with an 8½ inch OD tri-mill configuration was supplied to mill both the window and drill the rathole in a single trip.

RESULT

- Rapid mobilization from the WIS support base to the Northern Territory rig location was completed with on-time delivery.
- The TrackMaster Select was oriented and set, with window milled and rathole drilled in a single trip
- At surface, the tri-mill was within allowable gauge limits, despite the high compressive strength formation characteristics
- The subsequent 8½ inch directional assembly passed through window without issue, allowing the well to be drilled to TD.

Milling performance is highlighted in a high compressive strength formation sidetrack.

WIS mobilized TrackMaster Select equipment and experienced personnel to conduct an exploration well sidetrack in the Northern Territory, Australia. The system was set in 95⁄8 inch P-110 casing at a depth of 1199 m. The formation for the sidetrack was classified as medium-hard with a compressive strength of >13k psi. The system was oriented and hydraulically set at the desired depth. The milling and drilling time was 12 hours in total, for 4.7 m of casing and 3.3 m of formation. After reaching Total Depth (TD), the well was circulated clean, and the milling assembly recovered. The mill was determined to be in gauge and the subsequent directional drilling assembly was deployed and drilled the well to TD. It was notable that the mill gauge, and wear condition remained acceptable after a high compressive strength formation application such as this.

Used Mill Condition

Top right: Lead mill

Center: Follow mill

Bottom: Dress mill

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Fishing Operation Results in the Successful Recovery of a High-Value BHA and Restores Wellbore Access

The WIS team in Australia completed a fishing operation that saved significant cost to the customer, including a drilling BHA valued at $4.8 million.

CHALLENGE

A customer required the recovery of a stuck 8 ½ inch directional drilling assembly from a deviated well. The rig had been jarring on the stuck BHA for 48 hours prior to the WIS fishing supervisor's arrival on location. The risks of being unable to recover the fish was high.

SOLUTION

WIS mobilized an experienced fishing supervisor and the necessary equipment on short notice. The controlled backoff and washover operations were conducted successfully. A fishing assembly that included, the TMC jar and accelerator was deployed to deliver maximum downhole energy. This resulted in the prompt recovery of the fish.

RESULT

- Successfully retrieved the stuck rotary steerable, Penta combo logging, and directional drilling BHA.
- Saved the customer an approximate lost-in-hole cost of $4.8 million.
- Restored access to the original wellbore interval, which had already been drilled to section TD.
- A high degree of customer satisfaction was recognized.

Wellbore Integrity Solutions (WIS), Australia, in cooperation with the customer, successfully retrieved a complex directional assembly.

WIS was mobilized to provide fishing expertise to recover a stuck 8½ inch directional drilling assembly on a deviated production well. The section had been drilled to a TD of 2705 m, and the BHA had become stuck while tripping out of the hole at 2234 m. No rotation of the drill pipe was achievable, but full circulation was possible. The rig had initially been jarring with a 5⅛ inch drilling jar for 48 hours with no success.

On arrival at the rig location, a blind backoff had to be performed as the required wireline equipment was unavailable. The backoff was successfully accomplished just above the drill collars on the BHA, recovering the HWDP and drilling jar. The drilling jar was replaced with a larger size and jarring re-commenced; however, the fish remained stuck.

A second backoff was carried out above the drill collars, and a washover assembly was then deployed to clear the wellbore above the top stabilizer.

A Wellbore Integrity Solutions TMC fishing jar and accelerator were used on the second fishing run to maximize downhole energy at the stuck point. After 13 impacts from the fishing jar, the directional BHA came free with drag gradually reducing during the first stands.

The high-value directional BHA was successfully recovered and wellbore access restored. This cost-saving to the customer as a result of this successful fishing operation was recognized and highlighted.

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An Advanced, Low Side Casing Exit Successfully Deployed Using the TrackMaster Select* System

The WIS team in Australia worked closely with a customer in Australia to plan and execute a first low side sidetrack from 10¾ inch casing.

CHALLENGE

A customer required a low side casing exit from 10¾ in. 110HS casing at a depth of 4752 m to achieve the desired well path to target. The plan also required that the milling assembly mill through a steel casing centralizer at 4757 m. After sidetracking, 6 m of rathole was to be drilled to allow drilling ahead.

SOLUTION

WIS proposed and planned the use of a 10¾ TrackMaster Select System, specifically configured for a low side exit. A tri-mill was also selected to mill the window, the casing centralizer, and drill the rathole in a single trip. Experienced, local WIS personnel were also mobilized to ensure that the well site operations were executed in accordance with plans.

RESULT

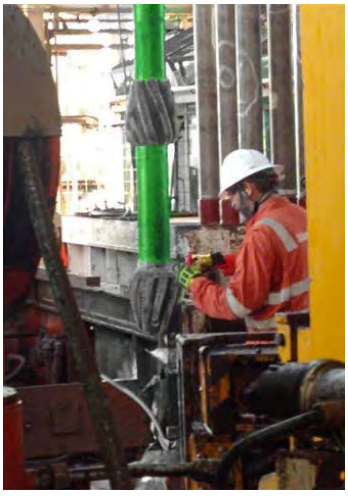
- A successful, low side casing exit was delivered in a single trip.
- The tri-mill configuration selected milled both the window and casing centralizer in addition to drilling 6 m of rathole
- At the surface, the mill was measured and found to be within allowable gauge limits
- The RSS directional assembly passed through window without issue, allowing drilling operations to continue to TD.

The versatility and configuration options of the TrackMaster Select System was demonstrated in a successful low side casing exit application.

A customer in Australia required the casing exit to be conducted from the low side of the wellbore, to accomplish the desired well path. The TrackMaster Select System was chosen for this advanced application because of its configuration options and track record in delivering low side exits.

After thorough planning, the system was set in 10¾ inch 66.7# 110HS casing at a depth of 4752 m and an orientation of 110 degrees right of high side (RHS). The total milling and drilling time was 11 hours for 5.0 m of casing, steel casing centralizer and 6.0 m of formation. After reaching Total Depth (TD), the well was circulated clean, and the milling assembly pulled from the hole. At the surface, the mill was measured and found to be in gauge, and the subsequent Rotary Steerable System (RSS) drilling assembly was run in the hole and drilled the well to TD.

The first low side TrackMaster Select whipstock deployed by WIS in Australia was well recognized by the customer. This successful sidetrack enabled the recovery of the well path to its original TD.



TrackMaster Select

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An Efficient Solution to Cut and Pull Casing, Offshore Indonesia

An innovative, motorized casing cutter BHA, enabled the use of a snubbing unit in a plug and abandonment (P&A) campaign instead of a conventional rig.

CHALLENGE

To achieve cost efficiencies in a P&A campaign, a customer wished to consider the use of a snubbing unit instead of a conventional rig as the difference in spread costs was significant. The ability to cut the casing was also an identified risk, due to the limited power and torque capabilities of the snubbing unit.

SOLUTION

An innovative, motorized casing cutter BHA was proposed to the customer to execute the job. The use of this BHA configuration allowed sufficient power to the cutter to ensure a successful cutting operation.

RESULTS

- A significant cost-saving solution was implemented successfully.
- The motorized BHA resulted in a successful cut in a few minutes with positive indication observed at the surface.
- The 9⅝ inches casing was also subsequently retrieved successfully.

The Wellbore Integrity Solutions (WIS) team in Indonesia successfully completed a 9⅝ casing cut and pull operation using a snubbing unit.

A major customer in Indonesia was assessing cost-efficient solutions for a P&A campaign. The use of a snubbing unit instead of a Jack Up Rig was considered to be a good solution to achieve cost objectives. The Wellbore Integrity Solutions team in Indonesia completed a thorough analysis and risk assessment in collaboration with the customer to provide an optimized solution for casing cut and pull operations. One of the biggest challenges was how to deliver the torque requirements with the power limitations of the snubbing unit. To enable the casing cutting operations, the team proposed the use of a mud motor run in tandem with the hydraulic casing cutter. The cut was made successfully in a few minutes with a positive indication of cut observed at the surface. The casing was also subsequently retrieved without issue. This solution provided significant cost savings to the customer.

WIS hydraulic casing cutter tandem with 7 inch OD mud motor.

Casing cut successfully after a few minutes.

Well Abandonment Technologies Deliver Outstanding Results, Offshore, Western Australia

Successful deployment of Wellbore Integrity Solutions pipe cutter and ProLATCH-N* wellhead recovery systems highlight one-trip efficiencies and the resulting time savings.

CHALLENGE

In an offshore environment, a well abandonment operation was required to be executed efficiently in a single trip. Three casing strings required to be cut. The 20 in. and 36 in. casings were also believed to be uncentralized, that generally results in longer cutting times and increases the risk of an additional trip.

SOLUTION

Wellbore Integrity Solutions proposed the use of its innovative portfolio of well abandonment technologies, including the ProLATCH- N well abandonment system to cut and recover the 20 in. x 36 in. wellhead assembly in a single trip. The ProLATCH-N system included a through rotating spear with a wellhead recovery profile and a heavy-duty pipe cutter that provided the one trip solution.

RESULTS

- 9⅞ in. heavy wall casing was cut rapidly and recovered.
- An efficient one trip solution was provided to cut both 20 in. and 36 in. casings and recover the wellhead assembly.
- The cutting time of 2 hours 15 minutes to cut both 20 in. and 36 in. casings was recognized to be faster than offset data examples.

Use of the latest well abandonment technologies demonstrates advantages in a high cost, offshore operating environment.

In a Western Australia, offshore well abandonment project, the customer recognized several notable achievements.

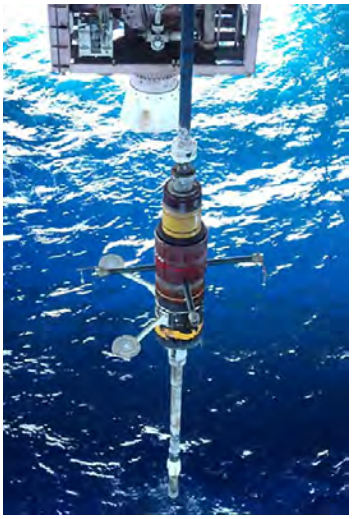
- A heavy wall 9⅞ inch casing string was tension cut in 4 minutes and successfully recovered.
- A ProLATCH-N wellhead recovery system, with a heavy-duty pipe cutter, dressed with the latest milling technology, was deployed to cut 20 inches and 36 casings and retrieve the FMC UWD-15-RL wellhead assembly in a single trip. Both casings were cut in 2 hours, 15 minutes, and the wellhead assembly recovered as planned. The time to cut both casings was determined to be significantly faster than offset examples.

Top Left: Casing cutter and wellhead in moonpool.

Top Right: Series 18 spear and wellhead at rotary table.

Bottom Left: Cut and recovered 20 in. 213# X-80 x 36 in. 748# X-56 casing at surface.

Bottom Right: Cut 97/8 in. casing at the surface.



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Continued Performance Reliability with the TrackMaster Select in Indonesia

Recent examples of successful one-trip sidetracks in East Kalimantan highlights a predictable, reliable performance in both 13⅜ in. and 9⅝ in. casing applications.

CHALLENGE

A customer required two successful single trip sidetracks in 13⅜ and 9⅝ inch casing. In both cases, an extended length rathole was required. The quality of the window created was also determined to be a critical factor in ensuring that the directional drilling bottom hole assemblies would not hang up when passing through the exit in the casing.

SOLUTION

WIS proposed and planned the use of the TrackMaster Select one-trip sidetracking system, with the optimized configurations required for the customers' specific objectives.

RESULT

- In both cases, a successful one-trip sidetrack was achieved.
- The milling time was considered to be "best in class" for the location.
- An extended length rathole was drilled in both cases.
- The mills used were determined to be within allowable gauge diameter tolerances after the window and rathole were completed.
- Subsequent directional drilling bottom hole assemblies passed through the window freely.

Wellbore Integrity Solutions, Indonesia demonstrated an efficient milling performance and delivered a high-quality window for the customer on two recent sidetracks during Q1, 2020 in East Kalimantan.

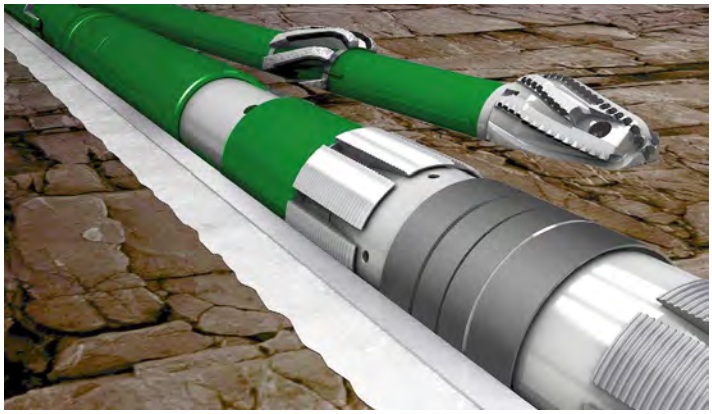
Example 1

The TrackMaster Select* system was configured with a hydraulic set, permanent packer style anchor. The window was milled in 9⅝ in. casing, and an extended length rathole was drilled in a single trip in a total of 6.2 hours. The Tri-mill was determined to be within acceptable wear tolerances when inspected on the surface. The subsequent Rotary Steerable System (RSS) bottom-hole assembly passed through the window easily.

Example 2

In the second example, a successful window was created in a single trip in 13⅜ in. casing. This TrackMaster Select system was also configured with a hydraulic set, permanent packer style anchor. The full gauge window was milled, and an extended rathole drilled in a total of 18.3 hours. When the mill was inspected on the surface, the dress mill section was measured to be full gauge diameter. The subsequent directional drilling bottom hole assembly also freely passed through the window.

In both the above examples, the milling time was among the "best in class" for the location. The customer expressed high satisfaction and recognized a notable performance from WIS.



TrackMaster Select

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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A Successful Sidetrack Operation in Malaysia Using a 9⅝ inch TrackMaster CH* Whipstock System Demonstrates Outstanding Milling Performance; Saves Rig Time and Cost

A sidetrack in 9⅝ casing was successfully delivered in a single trip. The window was milled and an extended rat hole drilled in a total of 2.5 hours.

CHALLENGE

To intersect a new target, the customer wished to sidetrack an existing depleted well. At the sidetrack point in the wellbore, the Dog Leg Severity (DLS) was greater than 3 degrees / 100 ft. Additionally, a casing centralizer was also located at the planned window location. To facilitate subsequent directional drilling operations, an extended rat hole length was also planned.

SOLUTION

WIS recommended running a 9⅝ inch hydraulic set TrackMaster CH whipstock system with a tri-mill configuration to both mill the window and drill the extended rathole length.

RESULTS

- A successful 1-trip sidetrack achieved with no additional cleanout run.
- The casing window was milled and extended rat hole drilled in a total of 2.5 hours.
- The planned operational rig time for the sidetrack was reduced and saved costs.
- The subsequent 8½ in. directional BHA passed successfully through the milled window and the well was drilled to Total Depth (TD), intersecting the desired target.

A best-in-class performance.

The use of the hydraulic set TrackMaster CH whipstock with its' innovative tri-mill configuration delivered a full gauge, high-quality window in 9⅝ inch casing, and drilled an extended rat hole in a total time of 2.5 hours. This is considered to be a record-setting performance in this location. The window quality was validated as the subsequent 8½ inch directional Bottom Hole Assembly (BHA) passed through the window with no problems.

A best-in-class 9 ⅝ in. TrackMaster CH whipstock system performance in Malaysia saves rig time and cost.

Wellbore Integrity SOLUTIONS

Use of ProLATCH-N Well Abandonment System for Woodside, Achernar-1 Well in Western Australia, Results in Significant Time Savings to Cut and Pull 20 in., 36 in. Casings and Wellhead

The successful use of the ProLATCH-N well abandonment system resulted in a 51% reduction in operational cutting time when compared to direct offset wells.

CHALLENGE

To efficiently complete an exploration subsea well abandonment, including 20 inch, 36 inch heavy wall casings and wellhead in a single trip.

SOLUTION

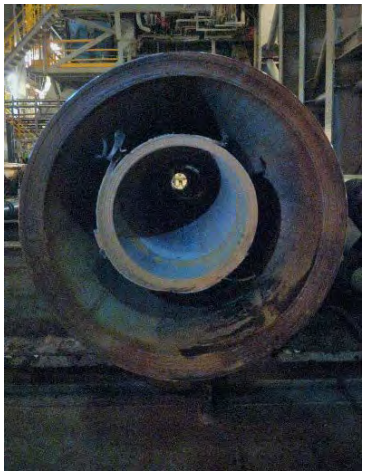
Wellbore Integrity Solutions (WIS) proposed the use of the ProLATCH-N* well abandonment system to cut both casings and recover the wellhead in a single trip. The ProLATCH-N system included a heavy duty pipe cutter dressed with a premium knife cutting structure and a thru-rotating spear equipped with custom segments to engage with the Dril-Quip wellhead profile.

RESULTS

- Both casings were successfully cut and the wellhead recovered in a single trip.
- The cutting time of 2 hours 12 minutes for the Woodside, Achernar-1 well, represented an average time saving of 51% when compared to direct offset wells of similar configuration and water depth.
- A smooth and efficient cut was noted during the abandonment process.
- No spills or HSE incidents.

A significant reduction in operational time.

The use of the ProLATCH-N* well abandonment system on the Woodside, Achernar-1 well project resulted in a significant reduction in operational time. The cutting performance on this particular abandonment operation was compared against 7 direct offset wells and an overall reduction of 51% in the average cutting time was determined. This can be attributed to the experienced personnel provided by WIS at the wellsite and the attributes of the ProLATCH-N system such as the heavy duty pipe cutter and knife cutting structure. The use of the thru-rotating spear and custom wellhead segments also formed an integral element of this single trip system.



Top Left: Thru-rotating spear and wellhead at rotary table.

Top Right: Wellhead in Moonpool

Bottom Left: Used 52 in. casing cutter knives

Bottom Right: Cut and recovered 20 in. 213# X-80 and 36 in. 748# X-56 casing at surface

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OUR VALUES

Define our company and how we conduct our business.

EUROPE AND SUB-SAHARA AFRICA

Wellbore Integrity SOLUTIONS

ProMILL Duo* Breaking Records in the North Sea

A plug and abandonment (P&A) operation utilizing the 7 inch x 9⅝ inch ProMILL Duo System achieved a new record by successfully milling over 200 ft of 9⅝ inch casing.

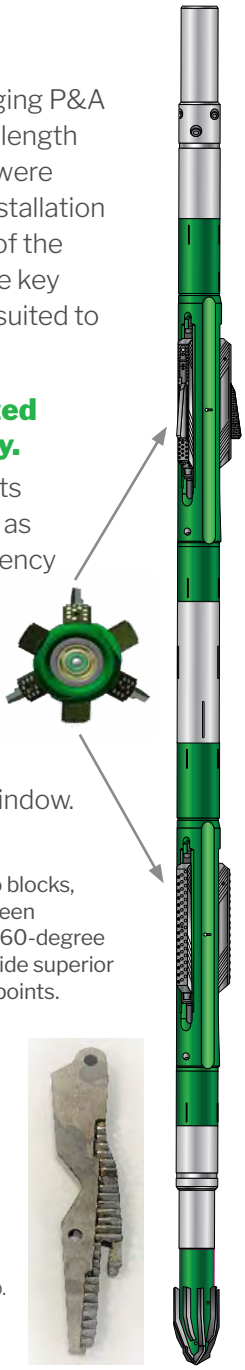
United Kingdom Contintental Shelf (UKCS) Well Abandonment Challenge.

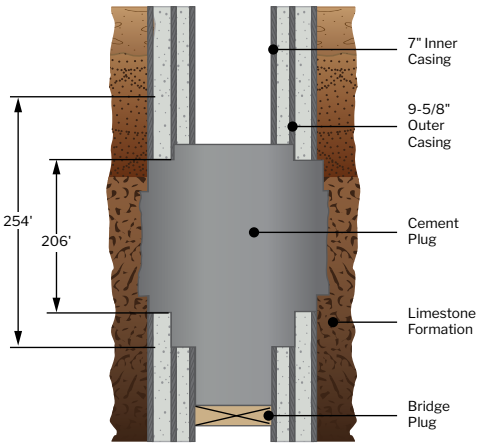
A customer in the UKCS recently completed a challenging P&A operation. The operation included milling an extended length section in both the 7 inch and 9⅝ inch casings, which were both cemented back to the surface, followed by the installation of an abandonment cement plug. Safety, the integrity of the abandonment process, and operational efficiency were key considerations. The ProMILL Duo system was ideally suited to accomplish these requirements.

TruEDGE* cutting technology and a customized knife configuration was deployed successfully.

The ProMILL Duo system dressed with TruEDGE inserts and custom-designed mill ahead knives was identified as the optimum solution, enabling maximum milling efficiency and resulting in significant time and cost savings, **reducing overall operations by 48.5 days**.

Detailed pre-job engineering and planning between WIS and the customer's representatives, combined with dedicated teamwork at the rig site, resulted in successfully delivering a 206 ft long 9⅝ inch casing window.





▲ Barrier design and operational depths.

▶ ProMILL Duo blocks, which have been oriented at a 60-degree angle to provide superior stabilization points.

▶ TruEDGE insert technology on the custom-designed mill ahead knives for ProMILL Duo.

ESG

OPERATIONAL EFFICIENCY

Reduced Safety Risk

Equivalent CO_2 Emissions:

2,845 METRIC TONS **REDUCTION**

OR

7,293,296 AVERAGE MILES SAVED

123,148 TRASH BAGS RECYCLED

CHALLENGE

In a complex well abandonment operation, the customer required a 206 ft long milled window interval in the 9⅝ inch casing. This necessitated a 254 ft long window in the 7 inch casing string to access the 9⅝ inch casing. To improve operational efficiency, the goal was to eliminate the requirement of milling these casing strings from the surface.

SOLUTION

The ProMILL Duo system was used to drift through the 7 inch casing and mill the 9⅝ inch casing. This eliminated rig time and operational cost to mill 6,500 ft of 7 inch casing from the surface. The use of TruEDGE* insert technology resulted in increased cutting structure durability, rate of penetration (ROP) and generated an ideal swarf shape to enhance overall performance.

RESULTS

- Successfully deployed ProMILL technology and milled a 254 ft 7 inch casing interval in a one trip.
- Successfully deployed ProMILL Duo through the 7 inch casing and created a 206ft long window in the 9⅝ inch casing.
- Rock-to-rock exposure for abandonment cement plug achieved.
- Eliminated the need to mill over 6,500 ft of the 7 inch casing, **48.5 rig time days saved** vs. conventional methods.
- Significant reduction in emissions produced from the operation (see ESG information above).

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Wellbore Integrity SOLUTIONS

Well·SENSE

Fiber Optic Logging in a European Geothermal Well

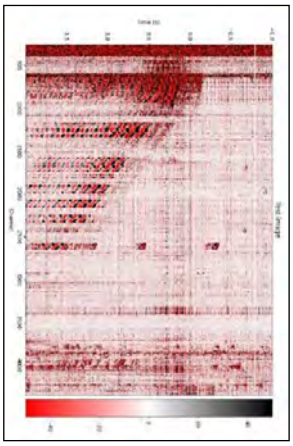
Following a well stimulation operation, FiberLine Intervention (FLI) technology, from Well-SENSE, was used successfully to provide a detailed temperature profile and seismic calibration data.

Efficient and high-quality data is provided offline and in an environmentally sensitive location. The wellsite contained no rig or intervention equipment.

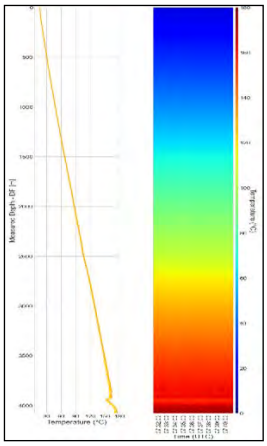
A customer had recently performed an intervention on a geothermal well with coiled tubing and had subsequently demobilized the intervention equipment. FLI technology, from Well-SENSE, was selected as an efficient solution and deployed to determine the impact on the temperature profile of the well and to calibrate the surface seismic monitoring network of geophones. The tools were deployed and, within 30 minutes, reached the required depth of interest at over 4000 m [13123 ft], capturing both distributed temperature and distributed acoustic sensing measurements throughout the wellbore. The temperature survey was completed in less than an hour.

An air gun source was fired into surface pits to calibrate the seismic network, the furthest being 2.7 km [1.7 miles] from the wellsite. Multiple shots were carried out over two days. Once sufficient data was collected, the master valve was closed on the wellhead, and the surface equipment was rigged down.

FLI tool - deployment ready.



Seismic data collected.



Temperature profile.

CHALLENGE

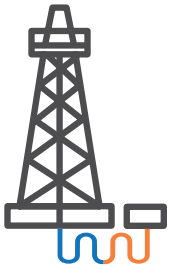
A customer had stimulated a Geothermal well and wanted to analyze the results of the stimulation. Calibration of the real-time seismic monitoring network was also required as they had previously been unable to accurately calibrate the depth of the seismic data. All of this needed to be achieved offline without a rig or intervention equipment, and it needed to be done with minimal impact on the environment.

SOLUTION

Wellbore Integrity Solutions (WIS) and Well-SENSE provided a disposable 2 ¾ inch FLI tool configured with DTS and DAS fiber. The tool was configured with a high-temperature DAS fiber to allow for extended life in the well. To calibrate the depth of the seismic monitoring network, an air gun source was used in water pits which were up to 2.7 km [1.7 miles] from the wellsite. Multiple shots were fired in each of the different pits.

RESULTS

- The tool was deployed into the well beyond 4000 m (13123 ft) depth within 30 minutes.
- The distributed temperature profile was obtained instantly
- The maximum temperature recorded was 177 deg C [350.6 deg F]
- Seismic data was recorded from an air gun source up to 2.7 km [1.7 miles] away.



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A Pipe Cutting Efficiency Record with TruEdge Technology, Offshore Holland

A heavy duty pipe cutter incorporating TruEdge* Technology Cutter Knives completed 5 cuts successfully in record times.

Wellbore Integrity Solutions (WIS) Netherlands successfully deployed a 16000 series pipe cutter with TruEdge cutting technology to cut 20 inch and 30 inch casings.

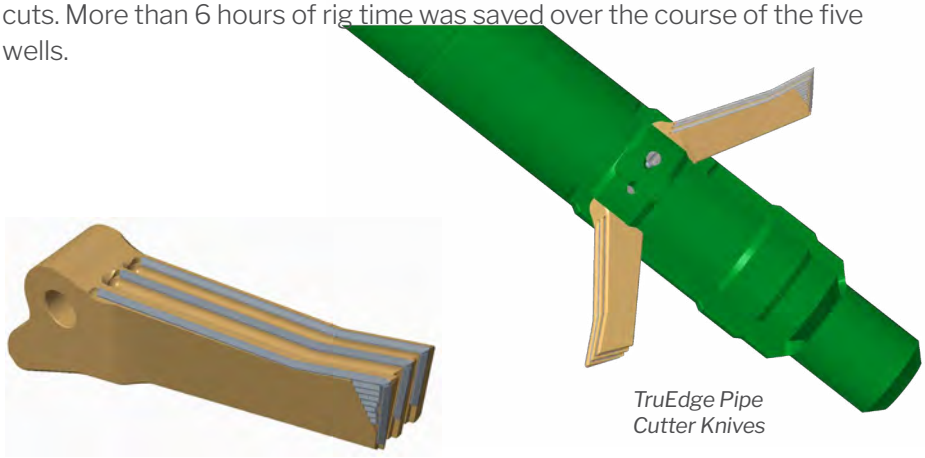
To improve operational efficiency, reduce rig time and cost, the WIS team in the Netherlands introduced the recently commercialized TruEdge milling and cutting technology to perform multiple cuts in both 20 inch and 30 inch casings on a Jackup rig, offshore Holland, with exceptional results. The solution provided with both the heavy duty pipe cutter and TruEdge technology offered the following benefits:

- Improved stabilization at cut
- Greater cutting structure durability
- Consistent sharp cutting edge
- Improved cuttings geometry

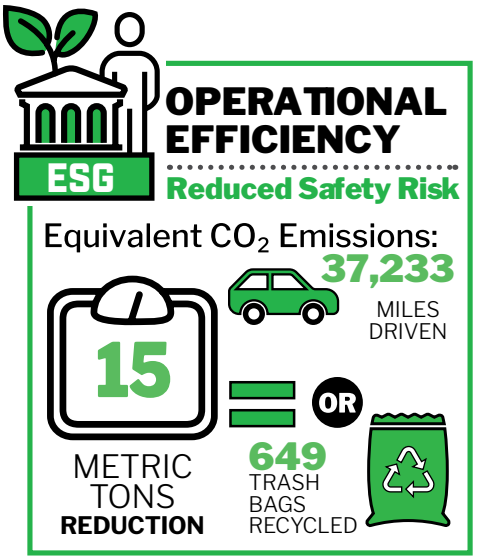
In addition to the significant time and rig cost savings realized, the corresponding emissions reduction was also considerable, as illustrated in ESG Operational Efficiency graphic.

A Record Performance

A single set of knives with TruEdge insert technology completed all five cuts. Cutting times across the five wells were 8, 8, 25, 36 and 37 minutes respectively. The pipe cutter knives were still in good condition after the five cuts. More than 6 hours of rig time was saved over the course of the five wells.



TruEdge Pipe Cutter Knives



CHALLENGE

- Improve efficiency and reduce rig time in offshore plug and abandonment operations.
- Ensure performance reliability in large diameter (20 inch and 30 inch) pipe cutting applications, irrespective of cement bond quality.

SOLUTION

- Use of a heavy duty 16 inch OD pipe cutter to improve stabilization.
- Use of 54.5 inch diameter opening TruEdge technology pipe cutter knives to increase cutting efficiency.
- Application of proven procedures and best practices.
- Experienced, local personnel.

RESULTS

- A single set of TruEdge technology knives performed 5 successful cuts with an average time of 22 minutes per cut, with the first and second cuts completed in 8 minutes.
- Over 6 hours of rig time was saved.

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TruEdge* Technology Delivers Outstanding Results in a Subsea Abandonment Application

Use of TruEdge technology reduced rig time and cost in a Subsea wellhead cutting and retrieval operation in the North Sea.

CHALLENGE

- Improve efficiency in Subsea Wellhead Abandonment operations.
- Ensure execution of the operation in a single trip.

SOLUTION

- A knife design, that incorporated TruEdge technology was developed for the WIS Heavy Duty Pipe Cutter to improve cutting efficiency.
- A parameter roadmap and an optimized BHA design was established specifically for the operation.

RESULTS

- The 20 in. x 35 in. conductor/ casing was successfully cut and the MS700 Wellhead retrieved in 1 trip
- A total of 2 hours and 45 minutes of cutting time was significantly faster than offset well comparisons.
- The TruEdge cutting structure was examined and exhibited good wear characteristics and no indications of abnormal damage.

Wellbore Integrity Solutions (WIS) successfully deployed a new casing cutting knife design — incorporating TruEdge insert technology.

While planning a Subsea Well Abandonment, WIS developed a new casing cutting knife for the WIS Heavy Duty Pipe Cutter, that incorporated the recently commercialized TruEdge technology, specifically developed for both improved casing cutting and milling applications.

The design and manufacturing process was expedited to meet the timeline for the operation with close collaboration between WIS Engineering, local WIS operations and the customer.

Specifications:

- MS700 Subsea Wellhead System
- Dual Casing Cut, 35 inch and 20 inch

The job planning process also included revised operational parameters for the new TruEdge technology and an optimized BHA design.

The casings were successfully cut and the wellhead retrieved in a single trip. The cutting time of 2 hours 45 minutes was significantly faster than direct offset wells.

WIS Heavy Duty Pipe Cutter with TruEdge cutting knives.

The 20 inch x 35 inch Cut Casings

A Customized PullMaster System with Large Scale Deflection Spear applied in a North Sea Conductor Recovery Operation

The Wellbore Integrity Solutions (WIS) PullMaster System was re-configured and deployed to generate high separation forces between 20 inch and 30 inch strings.

CHALLENGE

In an abandonment project, the 20 inch x 30 inch casings were stuck together. Conventional methods to pull the 20 inch x 30 inch together could not be used due to integrity and condition concerns with the original 30 inch conductor connectors used. A rapid solution was required within 3 weeks of initial inquiry.

SOLUTION

WIS proposed an engineered solution, that included the PullMaster system, a 20 inch large scale deflection spear with a custom fabricated C-Plate and billet stabilizer. This system provided a load rating of > 1.2 million lbs. Several design reviews and rigorous risk assessments ensured a flawless job execution.

RESULTS

- The customized solution was delivered quickly to the customer, on time.
- The system functioned as planned.
- During operation, over 700,000 lbf was applied to the casings in separation attempts.
- This solution has now been incorporated into other best practices when similar scenarios are encountered.

A unique engineering solution, including a PullMaster, Spear and a C-Plate to improve operational efficiency.

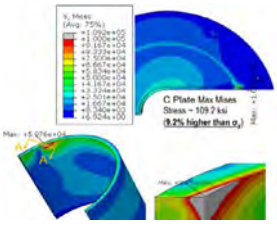
A customer in the North Sea required a custom solution for a conductor recovery operation, where the 20 inch and 30 inch casing strings were stuck together. Concerns over the integrity and condition of the original 30 inch conductor connectors also prevented standard practices from being used in this case. The local WIS team worked closely with the customer to provide a solution in a short time-frame.

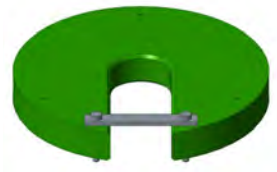
The WIS PullMaster platform offered an ideal Jacking unit between the 20 inch and 30 inch casings when mounted on a C-plate, as it provided the required pull force in attempts to separate the two casing strings. The C-Plate was designed to act as a landing point on the 30 inch casing and thereby ensured that a high pull force could be applied between the two stuck casings. Incorporating the large scale deflection spear in the BHA provided the flexibility to space-out as required.

WIS provides a rapid response.

The ability to respond promptly for our customer was demonstrated on this project. In a matter of a few weeks from the initial customer inquiry, a working solution was provided.

The solution development required close collaboration between the customer, the local WIS operational team and WIS Engineering. Design engineering, inclusive of finite element analysis, was conducted. The BHA configuration was optimized and rigorous operational Risk Assessments ensured a flawless job execution.

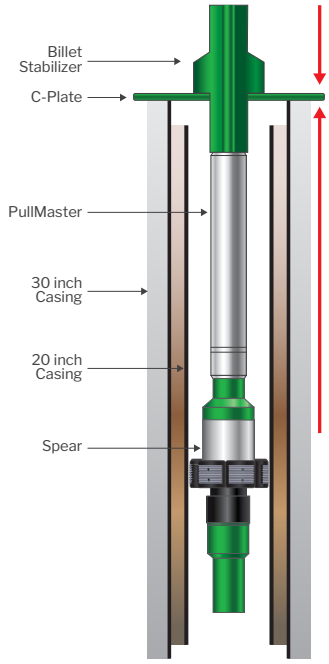




(top left) FEA Analysis on complete setup of operation

(bottom left) C-Plate

(right) BHA illustration. Arrows represent the forces acting on the BHA components



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Wellbore Integrity SOLUTIONS

ProMILL Duo* Dual Casing Section Mill Application Breaking Records In Northern Germany

A plug and abandonment (P&A) operation using the 9⅝ in. x 13⅜ in. ProMILL Duo system achieves a new record, 328ft long, 13⅜ in. casing window inside 18⅝ inch casing.

CHALLENGE

In a complex well abandonment operation, a client required an extended length window in both 9⅝ inch and 13⅜ inch casing strings. To maximize efficiency, the plan also required the elimination of the need to mill the inner 9⅝ inch casing from surface. Maintaining the integrity of the outer 18⅝ inch casing string was essential. With 13⅜ inch casing eccentricity inside the 18⅝ inch casing, the risk of damaging the 18⅝ inch casing was considered to be a significant risk.

SOLUTION

The ProMILL Duo* system was utilized to drift through 9⅝ inch casing and mill 13⅜ inch casing inside 18⅝ inch casing. This eliminated the rig time and operational cost to mill 3,040 ft of 9⅝ inch casing from surface. The use of WavEdge* insert technology resulted in increased cutting structure durability, rate of penetration (ROP) and generated an ideal swarf shape to enhance overall performance. The custom designed knives for milling 13⅜ inch casing inside 18⅝ also successfully eliminated any damage to the outer casing string, thereby maintaining the overall wellbore integrity during the abandonment process.

RESULTS

- Successfully deployed the ProMILL Duo through 9⅝ inch casing and created a 328ft (100m) long window in 13⅜ inch casing.
- Eliminated the need to mill over 3000 feet of 9⅝ inch casing from surface.
- Successfully scraped the ID of the 18⅝ inch casing using Expandable Scraper Technology deployed through 9⅝ inch casing.
- Preserved the overall integrity of the abandonment process by ensuring that there was no damage to the 18⅝ inch outer casing string.
- A successful, complex abandonment operation that was recognized by the client.

A well abandonment challenge in Northern Germany.

An International Oil & Gas Operator in Germany planned a challenging P&A operation on a well in Northern Germany. This required an extended length section milling interval for both the 9⅝ inch and 13⅜ inch casings prior to setting the cement plug. It was essential that this operation was carried out efficiently, and without compromising the integrity of the outer 18⅝ inch casing string. Wellbore Integrity Solutions recommended using the ProMILL Duo* system.

WavEdge cutting technology and a customized knife configuration deployed successfully.

The ProMILL Duo* system with WavEdge Inserts, and custom designed Mill Ahead Knives were identified as the optimum solution, enabling maximum milling efficiency and resulting in reduced rig time and operational cost.

Detailed pre-job engineering/planning between Wellbore Integrity Solutions and Operator representatives, combined with dedicated team work at the rig site, resulted in the successful delivery of a 328 ft/100m long 13⅜ inch casing window. As required, this was achieved with no damage to the outer 18⅝ inch casing string.

*Mark of Wellbore Integrity Solutions. Other company, product, and service names are the properties of their respective owners.

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A True One-Trip Section Milling Solution with New Milling Technology Successfully Delivers 50 meter Section Lengths

Using the ProMILL* system, two 50 m sections were successfully milled using knives dressed with both WaveEdge* and a new milling insert technology.

CHALLENGE

A customer required a one-trip solution to perform both cut-out and section mill two 50 m (164 ft) sections to allow the placement of rock-to-rock well abandonment barriers. In both cases, the sections were planned to be at a high well inclination.

SOLUTION

The ProMILL system was deployed to perform the cut-out and section mill each section in a single trip. For the second section, a new milling insert technology was introduced to increase milling performance in terms of durability and ROP.

RESULTS

- A true single-trip operation was provided for each section.
- A 50 m section was successfully delivered in both cases.
- A new milling insert technology was successfully introduced, that provided an increased ROP with reduced wear.

North Sea – Norway

Well: *C-2*
Rig: *Stafjord C*
Customer: *Equinor*

Wellbore Integrity Solutions, Norway successfully section milled two sections in 9 5/8 in. casing on Statfjord C, C-2 well, in the North Sea.

- Two section milled windows in 9 5/8 in. 53, 5lbs/ft, P110 casing were requested by the customer to establish a rock-to-rock abandonment barrier in Well C-2.
- The deepest section was milled using WaveEdge insert technology. Interval milled: 2395 – 2445 mMD at an inclination of 77-81 deg.
- The 2nd section was milled with a newly developed milling insert. Interval milled: 2289 – 2339 mMD at an inclination of 74-76 deg.

Both sections were successfully milled in a single-trip, with the new milling insert design providing a higher ROP (1.7 m/hr) and less knife wear (31%) compared to WavEdge inserts. The combination of the robust ProMILL design and experienced field service supervisors resulted in this successful field test for the newly developed milling insert design.

(top left photo) Wear profile on cutter knife

(top right photo) North Sea Statfjord C

(bottom left photos) Mill knives and cuttings

(bottom right photo) ProMILL with WaveEdge cutter knives

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New Extended Reach Spear Delivers Cut and Pull Efficiencies that Saves 1.6 days of Rig Time in the UK North Sea

The introduction of a new Extended Reach Spear (ERS) that has a wide opening diameter range, can be engaged and disengaged on-demand an unlimited number of times provided significant efficiencies in a 9⅝ inch casing recovery operation.

CHALLENGE

A customer required an efficient, single trip solution for 9⅝ in. casing cut and recovery using a Hydraulic Workover Unit (HWU) on an ongoing platform well abandonment campaign. Additional complexity, in this case, included re-entry into a damaged casing stump.

SOLUTION

WIS recommended and introduced new technology, the ERS, to tension cut and pull 9⅝ inch casing in a single trip. The use of the ERS also eliminated two dedicated runs that would have required using conventional techniques to dress and re-enter the damaged casing stump.

RESULT

- Successful introduction of a new Extended Reach Spear (ERS) in a well abandonment application.
- A true trip saving solution provided.
- 1.6 days of rig time saved.
- Customer recognition and appreciation received.

Trip saving new technology by Wellbore Integrity Solutions (WIS) was successfully used in an ongoing Well Abandonment campaign.

A UK North Sea customer wanted to improve efficiencies and save trips when cutting and pulling 9⅝ inch casing. The WIS team in the UK recommended the use of a recently developed Extended Reach Spear (ERS) to tackle this challenge. This solution offered numerous operational efficiencies and benefits, including:

- A short and easy to handle, rotary cut and pull BHA, with the ERS, placed directly behind the pipe cutter, ideally suited to the Hydraulic Workover Unit (HWU) used on the platform.
- The ability to hold casing in tension while cutting, facilitating both cutting and recovery in a single trip.
- On-demand hydraulic activation, with unlimited activation and deactivation cycles.
- A wider range of opening diameters for operational flexibility, without tripping.

Additionally, in this case, the casing stump had an irregular profile that conventional spears could not enter and engage. The use of the ERS eliminated this issue and saved two dedicated trips to dress off the casing stump.

The ERS passed through the damaged stump successfully

Casing cut in tension with ERS

ERS, post run condition

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Responsive Service and Flawless Execution Demonstrated in the Installation of a 9⅝ inch High-pressure Casing Patch in the North Sea

Wellbore Integrity Solutions was called upon to plan, mobilize, and successfully install a high-pressure casing patch during a work-over operation.

CHALLENGE

During a work-over planning process, the customer required a remedial option if the 9⅝ in. casing integrity was compromised. The planning and execution of this operation was requested on short notice.

SOLUTION

With the required equipment on the ground locally, WIS prepared a thorough procedure and mobilized the necessary equipment to cut and pull 9⅝ in. casing, washover the casing stump and dress off the casing profile to facilitate the installation of high-pressure casing patch. The casing patch was then installed and tested successfully to requirements.

RESULT

- A rapid response was provided to restore integrity to leaking 9⅝ in. casing, allowing work-over operations to continue.
- 9⅝ in. casing cutting, recovery and stump preparation were conducted efficiently and in accordance with plans.
- The high-pressure casing patch was installed and successfully tested.
- This casing repair operation resulted in maintaining the life and integrity of the well.

The Wellbore Integrity Solutions team in the UK planned and quickly mobilized the necessary equipment to conduct a 9⅝ inch high-pressure casing patch installation on a mature platform in the North Sea.

When a competitor was unable to deliver, a major operator in the North Sea, UK sector, contacted Wellbore Integrity Solutions (WIS) for rapid support to conduct a 9⅝ inch casing patch installation to repair a casing leak on a mature platform. After planning and equipment mobilization, experienced WIS field personnel successfully cut and recovered 9⅝ inch casing, washed over, and dressed the casing stump before deploying the casing patch. The casing patch was then spaced out, installed and successfully tested. Excellent pre-job planning, along with flawless operational execution, ensured that the customer maintained the integrity of the well allowing work-over operations to continue.

9⅝ inch high-pressure casing patch hanging in the derrick ready to run in hole and install.

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Wellbore Integrity SOLUTIONS

Remote Operation Techniques Successfully Applied in Norway

Wellbore Integrity Solutions (WIS) successfully planned and executed a remotely supervised cut and pull operation on the Norwegian Continental Shelf.

CHALLENGE

Due to personnel limitations at the rig site, the customer requested that a 9⅝ in. casing cut and pull operation be conducted remotely. The cut and pull operation required an emphasis on safe and efficient practices, with no compromises by the remote supervision aspect of this application.

SOLUTION

The operation was planned as a remote application that would be supervised from the WIS onshore base. Procedures and communication protocols were established to monitor and manage the operational steps. An experienced WIS manager was assigned to ensure successful execution.

RESULT

- A successful example of a 9⅝ in. casing cut and pull operation supervised remotely and in accordance with plans.
- No non-productive time (NPT) or safety issues were encountered.
- A validated best practice for future requirements.

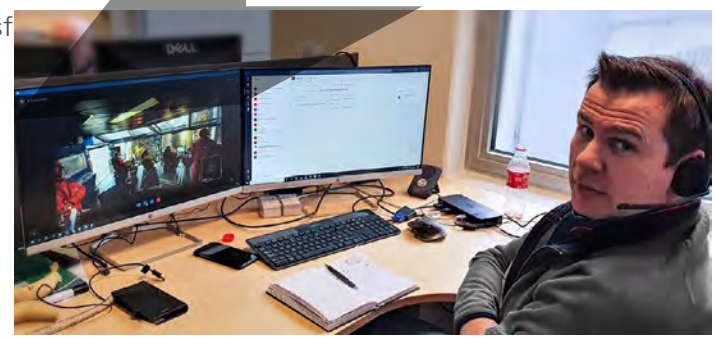
A combination of efficient planning and experienced personnel ensured the successful execution of a remote cut and pull operation.

A major customer, operating on the Norwegian Continental Shelf, required a 9⅝ in. casing cut and pull operation be remotely supervised from a base onshore instead of a dedicated supervisor present on the rig. Due to both limitations placed on the number of people at the rig site and as a means of increasing overall personnel efficiencies, delivering remote service capabilities is growing in many markets.

The WIS operations team, in Norway, worked with the customer to establish the necessary protocols, procedures, and communications to allow the successful execution of this cut and pull operation from the WIS onshore base.

The operation was monitored remotely in real-time by an experienced WIS manager. A live feed provided a rig floor view at all times along with the streaming of operational data as well. Audio communications were also in place to allow direct interaction between the WIS manager and the crew on the rig floor.

Because of careful planning and experienced remote supervision, this cut and pull operation was conducted successf



Real-time communications with experienced WIS manager at the shore base.

Left screen: Live feed of the drill floor and the driller on the rig.

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Section Milling with WavEdge* Technology Delivers Successful Results in a Challenging Application in the Gulf of Guinea, Republic of Congo

A section was successfully milled in 9⅝ inch casing using a snubbing unit with limited operational capabilities.

CHALLENGE

To optimize production and abandon the lower part of an aged well, the customer required a section to be milled as part of the remedial operation. This had to be done with an existing snubbing unit instead of a full rig. A section length of 13 m in a deviated wellbore was required to ensure operational compliance. The BHA tubulars available for this application was smaller than recommended for the type of section milling operation. Fluid losses during the operation also added to the challenges faced.

SOLUTION

WIS recommended running an 8200 series section mill, dressed with WaveEdge* knives to mill the section in a single trip. To optimize the performance, a hydraulic analysis using HART* simulation software for both the cut-out and milling phases with the limited operational parameters available was an essential part of the planning process.

RESULT

- Successfully milled the section in 9⅝ in. casing in one-trip.
- Effectively managed the milling operation with the limited operational parameters available and fluid losses encountered.
- Allowed subsequent abandonment and remedial operations to be completed trouble free.

A section was successfully milled using a snubbing unit.

To optimize production on an aged and depleted offshore well, a section had to be milled in 9⅝ inch casing as part of a remedial operation to eliminate cross-flow and abandon the lower part of the well. The most significant challenge in this remedial operation was to mill the window in a deviated well profile using a snubbing unit with limited capabilities in terms of power output. Small 3½ inch tubulars were also used in the section milling bottom hole assembly (BHA) which, placed limitations on the weight applied and torque generated during milling. The selection of WavEdge* technology ensured that the milling performance could be optimized, the section delivered in a single trip, and that the cuttings generated were small and consistent in size to aid in hole cleaning. Using experienced WIS personnel, the section was milled successfully, in accordance with the objectives.

A section milling application with WavEdge technology was used successfully in a remedial application to optimize production in an aged well in the Gulf of Guinea. The success of this application and the value generated was recognized by the customer.*

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We believe that **excellence in safety performance** and **environmental stewardship** are the guiding principles of good business.

LATIN AMERICA

Wellbore Integrity SOLUTIONS

CGX Energy Successfully Utilizes TrackMaster Select Whipstock for Open Hole Sidetrack in Guyana

Wellbore Integrity Solutions (WIS) and CGX Energy's collaborative efforts allowed setting a 12¼ inch one-trip TrackMaster Open Hole (OH)Whipstock System to restore drilling operations effectively.

A 13⅜ inch TrackMaster Select Cased Hole Whipstock transforms into a 12¼ inch Open Hole (OH) Whipstock sidetrack solution.

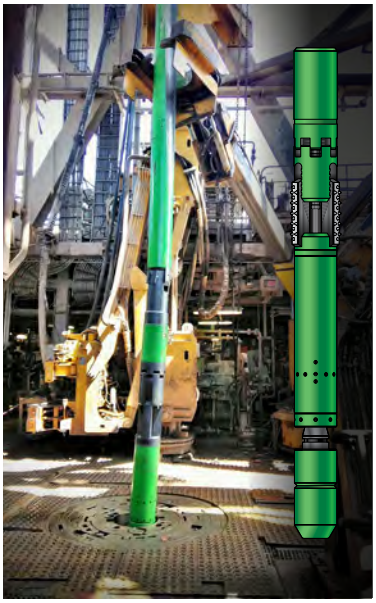
WIS collaborated with CGX Energy during the planning stage for an exploration campaign in Guyana. As part of the contingency plan for the 13⅜ inch casing section, TrackMaster Select Whipstock Systems were available in the country. During drilling operations and due to unforeseen events in the 12¼ inch open hole section, CGX Energy required immediate assistance from WIS to conduct an open hole sidetrack. Personnel and equipment were promptly mobilized to the rig location to address the challenge.

System versatility and the most reliable hydraulic expandable anchor saved approximately six days of redrilling the hole section.

The hydraulic anchor initially selected in the modular TrackMaster Select Whipstock system provided a large, variable expansion rate that does not require a bottom solid set in the casing or open hole.

This versatility allowed CGX to switch from their casing contingency plans to a superior solution, sidetracking in the open hole without mobilizing additional equipment. The TrackMaster Select OH Whipstock was tripped-in-hole (TIH) to the desired depth, oriented, and set successfully in the 12¼ inch hole section. The window and rathole was drilled, saving six days of time and 1,130 ft of the previously drilled open hole section.

Implementing the first TrackMaster Select OH Whipstock System in Guyana enabled CGX to smoothly depart above the problematic section and continue drilling to the target TD. This accomplishment highlighted outstanding teamwork and the consistent performance of the system in multiple applications.



CHALLENGE

- An unplanned sidetrack was required in an open hole to re-establish drilling operations after unsuccessful fishing attempts and unsuitable conditions for a conventional open hole sidetrack.
- The 12 ¼ inch open hole sidetrack should be delivered in a single trip with a suitable rathole in a challenging formation.

SOLUTION

- Utilize the 13⅜ inch TrackMaster Select Whipstock System with a hydraulic anchor and 12¼ inch tri-mills for an OH application.
- Orient with MWD and set the system at the appropriate depth for formation stability.
- Manage parameters to provide sufficient rathole for the subsequent BHA.

RESULTS

- Deployed and oriented the Whipstock with MWD in a high temperature well and set it in the 12¼ inch hole section at a depth of 18,771 ft.
- Milled a 25 ft window and 4 ft of rathole in 10 hrs and in a single trip.
- A successful open hole sidetrack was completed, allowing CGX Energy to continue drilling operations to the desired target depth.

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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A Successful, Horizontal Well Fishing Operation Ensures Drilling Continuity In Southeast Brazil

Experienced Wellbore Integrity Solutions (WIS) personnel made the difference when recovering debris in the horizontal section of a well.

Efficient debris recovery at a high wellbore inclination and in a single trip.

In general, fishing operations in high angle or horizontal wells increase both complexity and operational risk. For a customer in Southeast Brazil, drill bit debris in the horizontal section of the wellbore resulted in an unplanned, urgent fishing operation. While drilling the shoe track, two cones and the associated components from a 9½ inch OD Roller Cone Bit were lost-in-hole, at a wellbore inclination of 87 degrees. The local WIS Red Baron team were contacted, to assess the situation, prepare a plan and mobilize equipment and personnel to resolve the situation.

Working closely with the customer, the WIS team shared their experience, best practices, developed procedures, bottom hole assembly designs and contingency solutions for this fishing operation. The primary approach was to deploy a 6⅝ inch OD Reverse Circulating Junk Basket (RCJB) Bottom Hole Assembly (BHA) to circulate and recover the debris in the wellbore. The debris in the wellbore was recovered successfully at the first attempt, enabling the customer to resume drilling operations with minimal delays.

CHALLENGE

During shoe track drilling operations, drill bit debris was lost-in-hole. Recovering the debris was complicated by the 87-degree well inclination. The WIS Red Baron team supported the customer to plan and efficiently execute the operation at the wellsite.

SOLUTION

A BHA design that included a Reverse Circulating Junk Basket (RCJB) was used to recover the fish. The extensive operational experience of the WIS local team was a key element in the selection of the proper BHA that retrieved the fish.

RESULTS

- A rapid response mobilization of equipment and personnel to the rig site was conducted efficiently.
- In the fishing operation, all debris was successfully recovered at the first attempt.
- The customer recognized the value and experience of the local WIS team in completing this operation successfully.
- The rig returned to normal drilling operations in a timely manner, minimizing costly delays.

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Wellbore Integrity SOLUTIONS

Flawlessly Executed Operation Using the TrackMaster Select* Hard Formation System in a Deep-Well Application in Colombia

Four laterals were drilled in 7 inch casing to help increase the drainage area across the reservoir.

A multilateral well construction challenge in a deep, hard rock application.

The customer required a rapid response to execute a challenging deep-well multilateral project in the foothill plains of Colombia. Two of the customer's main objectives were to increase the drainage area across the reservoir thereby increasing production from the well.

The Wellbore Integrity Solutions' (WIS) Colombia team analyzed and simulated the critical facts concerning the operation before work began. The WIS operation team's dedication and expertise allowed them to successfully complete the first whipstock retrieval in Colombia and deliver superior performance with outstanding service quality.

SUMMARY OF WELL APPLICATION

Lateral No.	Top of the Well (ft)	Lateral Length (ft)	Casing	Formation UCS (Kpsi)
1	18,483	387	7 inch 32 ppf P-110 13% Cr	> 30
2	18,069	1,000		
3	17,249	94		
4	17,214	1,000		

Deep-well multilateral TrackMaster Select HF System project in Colombia.

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

CHALLENGE

The customer needed to enhance the drainage area across the reservoir. The best solution was to drill a multilateral well (4 laterals) in 7 inch, 32 ppf, P-110, 13% Cr casing. Possible torque issues dictated that the casing exit should be performed with a Positive Displacement Motor (PDM) in a high compressive strength formation.

SOLUTION

WIS recommended TrackMaster Select Hard Formation (HF) Systems configured with hard formation bi-mills to complete the four laterals successfully. After milling the windows, drilling to total depth continued and each lower completion deployed.

RESULTS

- Four laterals were successfully completed in a 7 inch, 32 ppf, P-110, 13% Cr casing and a hard formation with a UCS > 30 Kpsi.
- Whipstocks and anchors were successfully retrieved for each lateral.
- Subsequent directional drilling assemblies passed freely through the window, allowing drilling operations to continue.
- Lower completion assemblies passed freely through the windows to complete each lateral.
- The customer's objectives were achieved.

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Wellbore Integrity SOLUTIONS

Outstanding Cased Hole Sidetracking Performance in Latin America with the TrackMaster Select

Recent operational successes in Brazil and Mexico highlight the advanced capabilities of the TrackMaster Select system.

CHALLENGE

- Efficient milling of high strength and heavy wall casing strings
- The ability to drill the rathole with the milling BHA in high unconfined compressive strength formations
- Ensure reliability to complete the operation in a single trip
- Deliver a high quality, usable window to facilitate the continuation of drilling operations

SOLUTION

The TrackMaster Select system was configured to the specific requirements of these challenging applications. Proprietary Whipsim technology was used in the planning process to simulate and predict the desired results. The use of an Integral configuration tri-mill also ensured window quality, rathole gauge diameter and length.

RESULTS

- Demonstrated reliability to successfully complete the window and drill the rathole in single trip
- The time to mill the window and drill the rathole was reduced and exceeded customer expectations
- A high-quality window was delivered with the subsequent directional drilling BHAs passing through freely.

Location: Mexico

A 7 inch high strength cased hole sidetrack in a deep well with a high unconfined compressive strength (UCS).

An unexpected sidetrack, around a fish in the wellbore required optimization and risk assessment. Key considerations were:

- A deep exit point of 6,449 m (21,158 ft), in a cretaceous formation with 35 KPSI UCS
- A heavy wall, high strength, TAC140 grade casing to be milled with poor quality cement behind it
- High DLS, 9.27degrees/30 m, with a 1.83 bend steerable motor BHA to follow to slide drill away from the window and drill ahead to a TD of 8,011 m (26,283ft)

Thorough planning, the use of proprietary Whipsim technology and local experience combined to deliver a high quality window and rathole in one run with 10 hours milling and drilling time.

Location: Brazil

An efficient, cost-saving solution to sidetrack a 13⅝ inch high grade, heavy wall casing in a medium-hard formation.

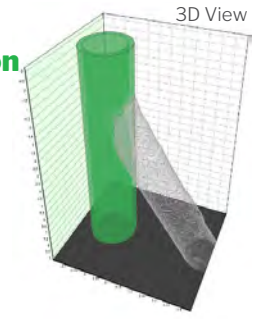
Facing numerous losses, a customer decided to sidetrack a well. A successful sidetrack would save 10,900 feet of previously drilled well bore in a high operating cost, offshore environment.

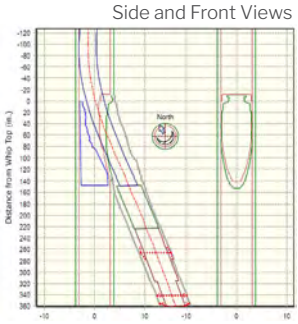
WIS worked closely with the customer to plan the 13⅝ inch OD 88.2ppf, C-110 casing exit using the TrackMaster Select system with a hydraulic, expandable anchor. Local knowledge and experience was utilized to ensure that the operational risks were fully assessed and mitigated.

An outstanding performance was recognized:

- The job was completed in one run, saving approximately 30 hours of rig time.
- The mill performance exceeded customer expectations, with minimal gauge wear.
- Drilling operations, to the target depth then continued, achieving the original well objective.

Whipsim Simulation Output





TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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Spotlight on Ecuador — Operational Performance and Reliability

14 consecutive cased hole sidetracks completed flawlessly with the TrackMaster Select* system and experienced local Wellbore Integrity Solutions (WIS) personnel.

CHALLENGE

Ensure that a high level of performance and service quality is maintained in cased hole sidetracking operations, in variable wellbore conditions.

SOLUTION

- Use of the field proven TrackMaster Select system, configured to meet the requirements of each individual sidetrack.
- Support from a local service facility with alignment to a global supply network to ensure the timely supply of equipment.
- Local expertise in planning, equipment preparation and wellsite execution of the jobs.

RESULTS

- 14 consecutive flawless cased hole sidetracks in a single trip
- 6 different customers
- 7 planned jobs and 7 unplanned jobs
- Included wells with poor cement conditions at the exit point
- Zero hours NPT / Zero Accidents / Zero Near Misses
- Average milling time of 5.5 hours

A Commitment to Operational Performance

To highlight and demonstrate operational excellence, 14 consecutive cased hole sidetracks, for 6 different clients have been completed flawlessly, in a single trip using the TrackMaster Select system. The sidetracks varied in terms of scope and requirements, including:

- Depth ranges from 6000 to 9000ft
- Formations at the exit with variable compressive strength
- Both right and left orientation of the whipstock
- Wellbores with poor quality cement adjacent to the exit point

Our commitment to excellence recognizes the critical contributions from the local WIS team in the planning and execution of these sidetracks. While 7 of these sidetracks were planned operations, the other 7 were unplanned requirements. The ability of our team to respond quickly to our clients needs in such circumstances is appreciated.

Spotlight on Ecuador, experienced local people, teamwork and proven technology

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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Wellbore Integrity SOLUTIONS

An Ultra Deep, Open Hole Sidetrack Success, Offshore Brazil

A challenging, unplanned open hole sidetrack was completed in an offshore exploration well using the TrackMaster Select* System.

CHALLENGE

In a high-cost, ultra-deepwater environment an unplanned sidetrack around a fish was required. Additionally, the formation to be drilled was medium-hard and abrasive.

SOLUTION

WIS recommended the TrackMaster Select System, which was configured and optimized for an open hole sidetrack application. Experienced local personnel was also provided to plan and execute the operation.

RESULT

- The open sidetrack was conducted with one less trip than planned, saving significant time and rig cost for the customer. The well objectives were subsequently completed.
- Minimal mill gauge wear was incurred, despite the medium-hard, abrasive formation drilled.

WIS provided an efficient, cost-saving solution to execute an 8 ½ in. open hole sidetrack in a medium-hard, abrasive formation in an ultra-deep offshore well with a sidetrack depth of 19,300 ft.

During drilling operations, a customer in Brazil faced an unplanned sidetrack due to a fish in the wellbore that could not be retrieved at a depth of 20,400 ft. To meet the well objective, a deep sidetrack was essential.

The Wellbore Integrity Solutions (WIS) team in Brazil worked closely with the customer to plan the sidetrack using an 8 ½ inch Open Hole TrackMaster Select system with an expandable anchor. Experienced personnel and equipment were mobilized to execute the operation, with the TrackMaster system hydraulically set at an anchor depth of 19,305 feet.

An outstanding performance recognition:

- The job was completed with one trip less than planned, saving approximately **36 hours** of rig time.
- This allowed the customer to complete the drilling and logging operation, thereby achieving the well objective.
- In a medium-hard, abrasive formation, the mill performance exceeded expectations, with the mills exhibiting minimal gauge wear.
- An 8½ in. OD stabilized rotary drilling BHA passed through the open hole window freely.

TrackMaster Select

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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Wellbore Integrity SOLUTIONS

Sidetracking Efficiency in Colombia

Use of the TrackMaster Select* System delivers a successful sidetrack in a high inclination and high dogleg severity (DLS) application.

CHALLENGE

A customer required a sidetrack in 9⅝ inch casing, at 68.2° degrees of inclination and a high DLS of 10.76°/100 ft at the whipstock system placement position.

SOLUTION

WIS recommended the TrackMaster Select whipstock system, which was configured with a tri-mill to successfully mill the window and drill the 12 ft rat hole in a single trip.

RESULT

- Successfully completed the window in 9⅝ inch casing in one trip.
- A total of only 9 hours was required to mill the window and drill the rat hole.
- The used tri-mill was within the acceptable gauge diameter as per criteria after the run assuring a high-quality window.
- Subsequent gravel pack assemblies passed freely through the window to complete the well at Total Depth (TD).

An optimized configuration, 9⅝ inch TrackMaster Select system, with hydraulic anchor and tri-mill assembly was mobilized to complete a challenging sidetrack.

The Wellbore Integrity Solutions (WIS) team in Colombia answered a customer's request to plan and execute a challenging sidetrack, onshore in Colombia. During the planning process, it was identified that, due to setting depth constraints, the TrackMaster Select system had to be placed in an interval with a high DLS.

The key considerations during the planning process were identified as:

- An exit point at 5,734 ft, 45° left of high side
- A high DLS of 10.76°/100 ft for system placement
- An exit point wellbore inclination of 68.2°
- A smooth directional assembly pass through to drill the 8½ inch OD hole section
- A requirement to also pass through a gravel pack assembly to complete the well

With experienced, local personnel, WIS planned and executed the operation efficiently and rapidly. The window was milled and the rathole drilled in a single trip, and in a total of 9 hours. On surface, the tri-mill configuration was checked and found to be within allowable specifications. Subsequent directional drilling assemblies and the gravel pack completion assembly all passed through the milled window freely.

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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A Successful Section Milling and Hole Enlargement operation in Colombia

An efficient abandonment operation in 7 inch casing was completed using a K-Mill and Underreamer in two days.

CHALLENGE

The customer required a section milled in 7 inch casing at a position where the casing collar was located.

SOLUTION

WIS recommended a K-Mill with tungsten cutters and an underreamer to successfully mill the section and enlarge the hole up to 16 inch diameter.

RESULT

- Successfully completed section milling operation in 7 inch casing, including the casing collar.
- Successfully enlarged the wellbore to 16 inch diameter.
- The operation was completed within two days.
- The section mill cutter knives and underreamer cutter arms came out of the hole in an acceptable condition after use.
- The customer then concluded the abandonment operation.

A K-Mill and underreamer configuration, with cutter knives to mill 7 inch casing and underreamer cutter arms to enlarge up to 16 inch OD, was mobilized to successfully mill the section and enlarge the hole.

Wellbore Integrity Solutions (WIS) in Colombia responded to a customer's request to plan and execute a challenging section milling operation where the cut out point was required to be at the position of a casing collar, at 2,675 feet.

Operational Parameters – Section Milling

Weight on Bit	Overall ROP (ft/hr)	Average Torque (UTR)	RPM	Flow Rate (BPM)	SPP (psi)
3	14	50 – 100	100	6	1,000

The hole enlargement operation, to 16 inch diameter, was also completed successfully. The customer was then able to conclude the abandonment operation.

Operational Parameters – Hole Enlargement

Weight on Bit	Overall ROP (ft/hr)	Average Torque (UTR)	RPM	Flow Rate (BPM)	SPP (psi)
2	7	10 - 70	70	6	1,200 - 1,350

Experienced WIS personnel worked closely with the customer to plan and prepare the specific procedures for this successful operation.

The condition of the dull knives and underreamer cutters were also evaluated post-run and found to be within tolerance.

Wellbore Integrity SOLUTIONS

Rapid Mobilization of TrackMaster Select in Mexico Recovers an Ongoing Exploration Well Sidetrack Successfully

A customer facing challenges in a sidetracking operation, mobilized the TrackMaster Select* system to sidetrack 13 3/8 inch casing and deliver a successful casing exit.

CHALLENGE

To recover an exploration well sidetrack program, that had accumulated significant NPT, a customer required a rapid solution to conduct a successful sidetrack and allow drilling operations to recommence following the desired plan.

SOLUTION

WIS recommended and mobilized a TrackMaster Select system and experienced, local personnel at short notice to complete this sidetracking operation. This was done successfully and in a single trip.

RESULT

- Rapid mobilization of equipment and qualified, experienced, local personnel within 24 hours, resulted in the delivery of the casing exit in a single trip.
- Both the window and rat hole were completed in 9.7 hours.
- On the surface, the milling assembly used was found to be within allowable wear tolerances, confirming that the window was of high quality and full gauge.
- Subsequent directional drilling assemblies passed freely through the window, allowing drilling operations to continue.
- The customer recognized the success from WIS to recover this sidetrack operation after incurring significant NPT with an alternative equipment supplier.

Wellbore Integrity Solutions Mexico, in collaboration with the customer, successfully sidetracked 13 3/8 inch casing, achieving a high quality, smooth window in a single trip with the TrackMaster Select system.

A customer had experienced three unsuccessful attempts to sidetrack a wellbore using a whipstock system from an alternative supplier. These attempts had resulted in significant Non-Productive Time (NPT), of 25 hours, at the well site.

As an urgent corrective action, Wellbore Integrity Solutions (WIS) was contacted to mobilize a TrackMaster Select system and field personnel to create a new casing exit. WIS had the required inventory available locally and experienced local personnel to conduct the operation. After mobilization, the operation was completed flawlessly in a single trip in a total of 9.7 hours. A full gauge, high-quality window was provided, and the subsequent directional drilling bottom hole assemblies passed through freely, to allow continued drilling operations.

OPERATIONAL DATA SUMMARY	
Casing Size, in.	13 3/8
Weight, Lb/ft	72
Grade	N80
Top of Whipstock, m	714.1
Operational Hours	9.7
Lithology	100% Shale

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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A Complex Fishing Application Yields Success in Ecuador

Experienced Wellbore Integrity Solutions (WIS) personnel planned and recovered a heavily corroded completion, allowing the restoration of well production in the Sucumbios region of Ecuador.

CHALLENGE

A completion recovery was required by the customer with the added risk of recovery complexity due to a severely corroded completion. Plans and contingencies required development and update at the wellsite to ensure a successful operation within the planned rig time allocated.

SOLUTION

WIS provided experienced personnel to plan and execute the operation. Locally positioned assets and supporting inventory were utilized to provide the necessary equipment for both primary and contingency retrieval bottom hole assemblies. The assemblies utilized were selected to minimize debris during the retrieval process.

RESULTS

- Efficient planning and contingency options resulted in a completion that was fully recovered with a rig time saving of two days.
- The customer was able to re-establish the desired production from the well.=

A heavily corroded completion resulted in an increased complexity fishing operation. WIS completed the operation successfully, saving two days of rig time.

A completion recovery, by the WIS team in Ecuador, developed into a more complex operation due to the heavily corroded condition of the completion string and packers. The completion string comprised of 3½ inch tubing, which was completely corroded in multiple areas (Figure 1&2), and two Quantum Hydraulic Packers, in both the 9⅝ inch and 7 inch casings (Figures 3&4).

Due to the unexpected, heavily corroded condition of the completion, contingency plans and alternative recovery bottom hole assemblies were prepared in real time at the wellsite to ensure operational continuity. For example, milling or washover operations were avoided in this case, to reduce the introduction of additional debris into the wellbore. The WIS personnel at the well site and support base worked closely with the customer at all times to deliver a successful completion recovery. Despite the issues encountered with the heavily corroded completion, the operation was concluded in two days less than planned.

Figure 1: Heavily corroded 3½ in. production tubing.

Figure 2: Debris inside the recovered upper Quantum Packer.

Figure 3: Broken 3½ in. production tubing pieces inside the upper Quantum packer.

Figure 4: Successful recovery of lower Quantum Packer.

Use of TrackMaster Select System Saves 36 Hours of Rig Time in a Challenging Application in Mexico

An outstanding one-trip performance using the Trackmaster Select* system delivers a successful deep sidetrack in a 9⅞ inch high strength casing.

CHALLENGE

A customer required a deep sidetrack, in 9 ⅞ in, 62.8 ppf TAC-140 casing with the presence of poor cement behind the casing. A rat hole in a high compressive strength (>20ksi) formation was also required. A one-trip solution was desired with the delivery of a full gauge window for the trouble-free re-entry of subsequent drilling assemblies.

SOLUTION

WIS recommended a Trackmaster Select whipstock system, configured with an integral construction tri-mill with a hybrid cutting structure to complete this challenging application.

RESULT

- Successfully completed a window in 9⅞ in. 62.8 ppf TAC-140 casing in one trip.
- 36 hours of rig time was saved.
- The integral tri-mill was within acceptable gauge diameter criteria after the run, assuring a high-quality window.
- Subsequent directional drilling assemblies passed freely through window to continue drilling the 8½ in. section to TD.

An optimized TrackMaster Select configuration, with an integral tri-mill, was prepared to successfully sidetrack from high strength casing and drill a rat hole in hard formation.

Wellbore Integrity Solutions (WIS) in Mexico responded to a customer's request to plan and execute a challenging sidetrack, onshore in Mexico. The specific criteria that made this a challenging application included:

- Deep exit point of 6,700 m (approximately 22,000 ft), 270 degrees orientation
- High temperature
- High strength, grade TAC-140 casing
- Poor cement quality behind the casing
- High compressive strength formation, greater than 20,000 psi, comprising, conglomerates, shale, sandstone, and traces of limestone

Historical records indicated that this sidetrack application should require two trips. However, for this sidetrack, WIS recommended the use of the new integral design tri-mill with a hybrid cutting structure. This configuration selection resulted in an outstanding one-trip sidetracking performance. The casing was successfully milled, and the rathole drilled in a total of 20 hours. The follow mill was measured to be within 1/32 inch of full gauge and the dress mill at full gauge when inspected on the surface, assuring that the window that had been created was of high quality. The subsequent directional drilling bottom hole assembly (BHA) passed freely through the window and continued to drill ahead as planned.

A significant time saving of 36 hours was recognized in this application.

TrackMaster Select

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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A Successful Fishing Workover Application in Colombia Includes the Recovery of Six Packers and Reduces Operational Time by Three Days

Utilizing Wellbore Integrity Solutions' experience in fishing operations, a complex completions string recovery was planned and successfully executed, saving three days of rig time.

CHALLENGE

A planned workover required the recovery of a complex completion string consisting of six retrievable packers, three inside 9⅝ in. casing, and three inside 7 in. liner. The overall operation required detailed planning and risk assessment as multiple critical packer shear loads had to be considered. The mechanical limitations of the 3 ½ in. EUE tubing in the completion string and the shear safety joints' ratings also required consideration in the planning process.

SOLUTION

Experienced Wellbore Integrity Solutions (WIS) personnel developed a customized procedure for this workover operation. The procedure was designed to ensure correct loads were transferred to each packer and avoided the premature release of the shear safety joints. The selected bottom hole assemblies (BHAs) utilized standard external and internal catch fishing tools, and impact tools to maintain a cost-effective solution. Experienced well site personnel were deployed to ensure the operation could be completed successfully.

RESULT

- The complete completion string was recovered successfully, with the minimum number of trips.
- No service quality incidents occurred during the ten day operation.
- The operation finished with a time savings of three days and a cost reduction for the customer.

WIS planning and experience delivers a successful workover fishing operation to recover a complex completion string.

A customer in Putumayo, Colombia, had a requirement to workover a well completion that included six packers of varying types. A program was designed to optimize the recovery process, consider the multiple component shear loads, and the limitations on the overpull that could be applied. In the planning process, four primary retrieval bottom hole assemblies (BHAs) were selected, all including impact tools. The entire completion string was recovered successfully in fewer operational days than originally planned. Combining WIS' knowledge, experience, and operational diligence delivered a successful workover operation for the customer.

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First 13⅜ inch TrackMaster Whipstock System Successfully Deployed in Latin America by Wellbore Integrity Solutions, Mexico

Successful one-trip deployment of 13⅜ in. TrackMaster at depth of 2,373 meters on the Ixachi – 11 well, Tierra Blanca, Veracruz, Mexico

CHALLENGE

Successfully sidetrack from 13 ⅜ inch casing at a depth of 2,373 meters in a shale formations with an orientation of 41.36°. After sidetracking, drill 7 meters of Rat Hole to enable directional drilling to continue to a depth of 4,200 meters.

SOLUTION

Run a 13 ⅜ inch TrackMaster-CH Whipstock system with a tri-mill to mill the window and drill the rat hole. Orient the system with a Gyro.

RESULT

- Successful one-trip sidetrack achieved
- 12¼ inch hole recovered to reach planned total depth

First 13 ⅜ inch TrackMaster Whipstock system was successfully deployed in Latin America by Wellbore Integrity Solutions, Mexico.

Wellbore Integrity Solutions, Mexico in cooperation with the customer successfully deployed its first TrackMaster Whipstock system in Latin America.

The system was set in a 13⅜ inch casing #72 TAC – 110 casing at 2,373 meters on the Ixachi – 11 well. Milling time was a record of 6.78 meters in 10.19 hours and a rat hole record of 7 meters in 5.13 hours. The BHA with a PDM was passed through the window with no problems.

The dull grade condition of the mills were in specification after job completion.

The first TrackMaster Whipstock deployed by WIS in Latin America, gained the total satisfaction of the customer. This successful sidetrack enabled the recovery of the well to its original TD.

Customer Focused

At WIS, we create a culture that is focused on meeting and exceeding customer expectations.

MIDDLE EAST, INDIA AND NORTH AFRICA

Wellbore Integrity SOLUTIONS

TruEdge™ Technology in Action. A Unique Challenge in Qatar.

Wellbore Integrity Solutions (WIS) TruEdge* technology from our Red Baron product line demonstrated superior performance in both cutting and milling a Corrosion Resistant Alloy (CRA) liner in Qatar.

TruEdge technology enables liner recovery and a subsequent successful sidetrack.

In an offshore well, a 7 inch, 29 ppf CRA-110 liner became stuck during conveyance and could not be retrieved. The local WIS team in Qatar was mobilized to perform remedial services, including section milling and pipe cutting. Working closely with the customer to address the known challenges of both section milling and cutting the CRA liner, TruEdge technology was successfully used.

Section Milling:
To ensure the proper permanent abandonment of the cap rocks to prevent cross-flow contamination of the reservoir, 2 section milled windows were required in the CRA liner in a 61-degree tangent section at depths of 16,100 and 14,375 ft, respectively. Each joint of liner also included two centralizers to be milled.

Pipe Cutting:
The CRA liner was also required to be cut just above the 9⅝ inch casing shoe to enable a sidetrack at the desired zone. The sidetrack point selection was essential to avoid exposing 2 critical formations simultaneously. After cutting successfully, the liner was retrieved using a spear-fishing BHA.

The CRA challenge:
With a high chrome and nickel content, the milling and cutting operation was known to represent a significant technical challenge. The effective milling and cutting of this material during the project was considered to be an industry first.

CRA-110, for severe environment applications, high concentration CO_2, H_2S, and Chlorides	
Representative Properties:	
Cr(%)	24.0 – 27.0
Ni (%)	29.5 – 36.5
Yield Strength(ksi)	100 Min – 140 Max

This challenging operation was remediated successfully. After liner recovery, a 9⅝ inch TrackMaster Select system with an extended window profile was deployed to sidetrack the wellbore to plan.

Figure 1: Post-run section mill (Note TruEdge cutting structure minimal wear)

Figure 2: Post-run dull condition of pipe cutter knives

Figure 3: View of the cut on the 7-inch CRA-110 liner

CHALLENGE

- Perform cut-out and section mill 2 x 30 ft windows in CRA-110 liner to enable the placement of rock-to-rock barriers across the cap rocks.
- The liner to be milled is stuck but is uncemented. Each joint of liner includes two centralizers that increases the milling challenge.
- Cut and Pull 7 inch, 29 ppf, CRA-110 stuck Liner to enable the wellbore to be sidetracked close to the 9⅝ inch casing shoe.

SOLUTION

- Deploy the ProMILL™ system to perform cut-out and section mill in a single trip
- Introduce knives with new TruEdge™ inserts, delivering increased durability and ROP
- Deploy the 5⅝ inch hydraulic pipe cutter with TruEdge™ inserts to cut the liner

RESULTS

- An industry-first application for both section milling and cutting the liner
- **Section Milling**
  - The TruEdge™ inserts on the 5500 ProMILL knives delivered excellent results
  - Excellent swarf recovery at surface
  - Rock-to-rock barrier enabled
- **Pipe Cutting**
  - TruEdge™ inserts on the 5⅝ inch pipe cutter knives delivered a precision cut on the liner
  - Cut was completed in less than 7 minutes at 12,221 ft, just above the casing shoe
  - The 7 inch liner was retrieved on a separate trip with a spear-fishing BHA
  - Access provided to sidetrack the wellbore at the desired depth and successful sidetrack concluded

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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Wellbore Integrity SOLUTIONS

A Unique Thru-Tubing (TT) Milling Challenge in North Africa with Outstanding Results

Recent operational successes in North Africa highlight the advanced capabilities of Wellbore Integrity Solutions (WIS) milling tools, TT Motors, and TT Double Acting Jars.

Thru-Tubing frac plug milling solutions in a horizontal well with a 4½ inch 15.1# fracturing completion.

The WIS North Africa team was contacted to bring their expertise to a frac plug milling operation. The customer advised that the competitor's performance did not meet expectations due to additional trips and lengthy plug milling times. A key consideration in this operation was also frac sleeve diameter restrictions in the completion, which increased the risk of the BHA becoming stuck.

WIS worked closely with the customer to analyze the application, assess the operational risk and determine the best solutions.

Implementation of Best Practices:

The implementation of best practices were essential in achieving operational success.

- A proprietary WIS mill design was used for the type of frac plug. Using this mill design reduced the milling time per plug from 7 hours to 30 minutes.
- The fluid system was optimized to maintain the desired underbalanced conditions and provide good hole cleaning.

Operational procedures and parameters were also reviewed to include:

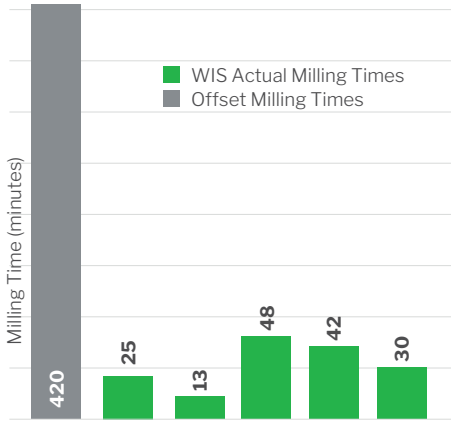
- Constant weight on mill (WOM) and motor differential pressure to optimize ROP and minimize the cutting size. The WOM applied was also adjusted to reduce the risk of plug spinning.
- Exercising caution while passing through frac sleeve restrictions.
- Using the WIS TT double-acting hydraulic jar with high impact forces as an essential part of the BHA.

Thru-tubing motor

Proprietary mill design

Thru-tubing double-acting hydraulic jar

Performance Comparision (Milling Times)



CHALLENGE

- Improve frac plug milling time and efficiency in a horizontal multi-stage fracturing completion.
- Minimize risks of BHA sticking incidents while passing through completion ID restrictions..

SOLUTION

- Definition and implementation of best practices in terms of job planning and operational procedures.
- BHA design optimization with the inclusion of a proprietary mill design for the type of frac plug.
- Comprehensive local support with experienced personnel.

RESULTS

- Reduced average milling time with WIS proprietary mill design per frac plug from 7 hours to 30 minutes.
- Demonstrated reliability and consistency of performance.
- Reduced rig time and cost, exceeding customer expectations.

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An Advanced Open Hole Sidetrack Application Saves 800 ft of Drilled Interval in a Middle East Well

A TrackMaster* OH system was successfully deployed across another previously set whipstock and through several washout areas to complete an unplanned sidetrack objective.

CHALLENGE

The customer required an OH sidetrack to save a previously drilled 800 ft interval of 8⅜ in. open hole and continue drilling operations to TD. The whipstock had to be conveyed across the earlier placed whipstock and pass through several washout areas to reach the desired setting depth.

SOLUTION

With thorough planning and experienced local personnel, the TrackMaster OH whipstock system was conveyed to the desired depth and set in position. The Open Hole Sidetrack was then completed successfully. The operation was concluded in a single trip.

RESULTS

- The 8⅜ in. open hole sidetrack was completed in one trip and saved 800 ft of previously drilled interval.
- The sidetrack was completed in a total of 6 hours.
- The used bi-mill was within the acceptable gauge diameter as per criteria after the run, assuring a high-quality sidetrack.
- The subsequent directional RSS BHA passed freely through the window to continue drilling and meet the customers' objectives.

Openhole sidetrack accomplished in 8⅜ inch hole size using the TrackMaster OH system.

As a result of a stuck pipe cutting operation, the WIS team worked closely with the client to develop a solution to sidetrack the well, taking into consideration the following points:

- The TrackMaster OH system had to pass across a previously set open hole whipstock set at 100ft below the shoe.
- The second whipstock was to be set at 800ft below the shoe, at an inclination of 30-degrees.
- The system was to be conveyed across several washout zones, as identified by the caliper log.

This advanced open hole sidetrack was planned and executed successfully in a single trip. The subsequent directional RSS assembly passed freely through the window to continue drilling, saving 800 ft of the previously drilled interval and meeting the overall well drilling objectives.

A Unique Sidetracking Challenge was Completed with the Trackmaster Select* in the Middle East

With a record mud weight and placement right above the liner shoe, the TrackMaster Select* system enabled a successful cased hole sidetrack in a single trip.

CHALLENGE

A sidetrack in 7 inch liner was required, with placement only 3 ft above the liner shoe. The planned mud weight required was also considered to be a record of 19.78ppg.

SOLUTION

The TrackMaster Select whipstock system, configured with a tri-mill and bypass valve was successfully used to mill the window and drill the rathole.

RESULTS

- Successfully completed the window in 7 inch liner in one trip.
- The window was milled and the rathole drilled in a total of 5.2 hours.
- The used tri-mill was within the acceptable gauge diameter as per criteria after the run, assuring a high-quality window.
- The subsequent directional drilling assembly passed freely through the window.

A 7 inch TrackMaster Select system with hydraulic anchor, tri-mill assembly and multicycle valve completed this challenging sidetrack.

A unique challenge was successfully planned and executed by the local WIS team, while working closely with the customer.

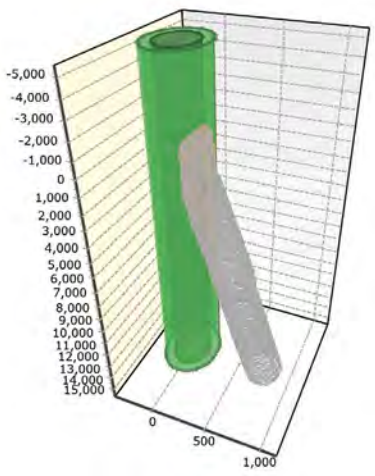
Key Considerations:

- An exit point was required at 9,847ft in 7 inch liner 32 lbs/ft liner degrees.
- A record mud weight of 148 PCF/ 19.78ppg was required in this application.
- Setting the system only 3 ft above the 7 inch liner shoe also carried operational risk.
- The rotary steerable system drilling assembly should pass through the window to drill the 5⅞ inch hole section to TD.

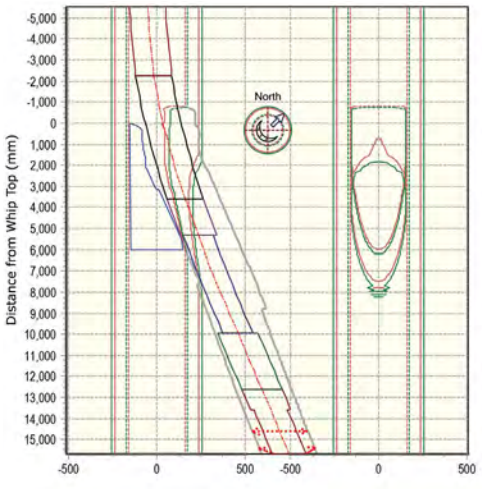
The operation was planned and executed successfully in a single trip. The window was milled and the rathole drilled in a total time of 5.2 hours. The tri-mill configuration was checked and found to be within allowable specifications. Subsequent directional drilling assembly passed through the milled window freely.

Example: Whipsim simulation output.

3D View



Side and Front Views



TrackMaster Select

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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An Advanced Dual Casing Exit Success, Offshore India

The TrackMaster Select* system was used to create a 13⅜ x 20 inch dual casing exit successfully in a single trip.

CHALLENGE

A dual casing sidetrack, in 13⅜ and 20 inch casing was required in a vertical well where the casing was known to be uncemented at the exit point. The goal was to complete this operation in a single trip, and, to ensure that the subsequent directional drilling BHA could pass freely through the dual window profile.

SOLUTION

WIS proposed and planned the use of the 13⅜ inch TrackMaster Select* cased hole whipstock system utilizing 12 ¼ inch bi-mills to provide the client with a full gauge window. Whipsim* simulation software was also used as an integral part of the planning process.

RESULT

- A successful dual casing sidetrack was completed in a single trip using a 13⅜ inch TrackMaster Select whipstock system.
- The system was set at a depth of 276 M, and both windows were milled and rat hole drilled in 11.5 hours.
- The subsequent directional drilling BHA passed through the window without any issues and drilled ahead.

A challenging application planned and executed by the Wellbore Integrity Solutions (WIS) India team.

Dual casing exits are considered to be challenging projects. In this case, the exit was required in a vertical well, in both 13⅜ (68 ppf) and 20 inch (133 ppf) casing sizes. Uncemented casing at the exit point also increased the complexity of the operation. The WIS team in India responded to the client's requirements rapidly and thoroughly planned and executed this operation with a total milling and drilling time of 11.5 hours.

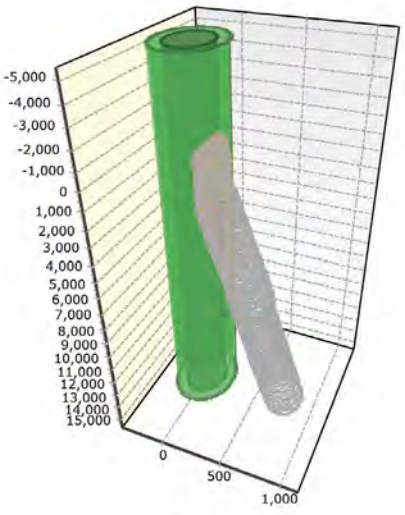
The value of Whipsim.

As part of the planning process, WIS' proprietary Whipsim* simulation software was used to predict the dual window opening profile, trajectory and volume of steel to be removed. In this case, almost 900 lbs of steel was projected to be milled.

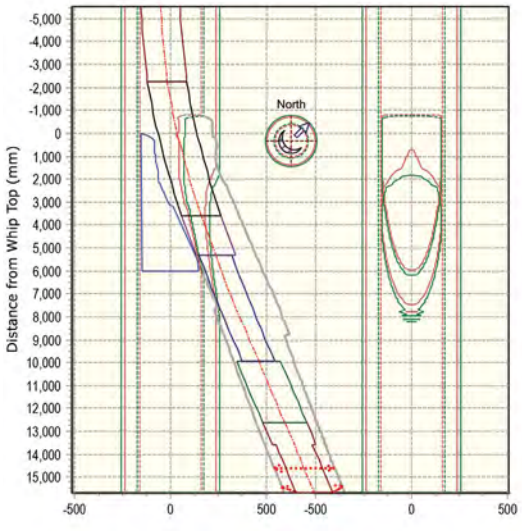
WIS combined best practices, risk analysis processes, and an experienced local team to deliver this outstanding result.

Whipsim simulation output.

3D View



Side and Front Views



TrackMaster Select

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Wellbore Integrity SOLUTIONS

ProMill Duo* Application Sets Record of an 111 ft window in Qatar

Barrier restoration across 7 inch and 9⅝ inch casings achieved successfully.

CHALLENGE

- Section mill casing to restore cap rock barrier across 7 inch and 9⅝ inch casing
- High ratio opening for section milling 9⅝ inch casing from inside 7 inch casing
- Underream the open hole to provide rock-to-rock zonal isolation

SOLUTION

Deploy 6000 Series ProMill Duo to drift through 7 inch casing and section mill 9⅝ inch casing to the desired depth. Subsequently, enlarge the wellbore to achieve a high quality rock-to-rock abandonment barrier.

RESULT

- An estimated saving of 40 days was accomplished. A long interval of 7 inch casing milling was eliminated using the ProMILL Duo technology
- The window length of 111 ft was a record run for the 6000 Series ProMILL Duo. This was completed in a single run.
- No operational down time occurred. A highly efficient operation was recognized by the client

Dual Casing Section milling 7 inch and 9⅝ inch casing.

When cap rock sealing restoration was required in a complex, well abandonment project, the client contacted WIS. The challenge was to mill the inner 7 inch casing, that was cemented to the surface, without damaging the outer 9⅝ inch casing and then mill the 9⅝ inch casing by drifting through the 7 inch casing with minimal trips when compared to standard conventional methods. WIS recommended the new ProMILL Duo technology with high ratio section milling capability that enables a rock to rock seal in a dual casing section milling application.

Operational challenges were mitigated by using both the standard section mill and the new ProMILL Duo technology. The ProMILL Duo is a combination of a unique, high expansion ratio hydraulic section mill and a precisely oriented hydraulic stabilizer below it. This creates a unique 6-point stabilization system that helps to minimize dynamic loads and vibrations in the BHA. The ProMILL Duo is deployed once the inner 7 inch casing window has been milled. An underreamer is also utilized to achieve a 13.5 inches diameter window to enable a rock to rock seal.

Detailed pre-job planning is essential.

To mill the windows at the cap rock depth, particular attention was placed on starting and ending depths. Detailed road maps were created to optimize the operational parameters for the job. The job procedures included both risk assessments and mitigation measures. Milling fluid rheology including, in particular, yield point optimization during milling was monitored to ensure that swarf recovery was accomplished efficiently. The operation was initiated with the inner casing window being milled in two stages. The cut initiation run on the 7 inch casing was completed using rapid cut out knives. This was followed by section milling 139 ft of 7 inch casing using the flush knife design with high performance WavEdge* insert technology. The flush knives ensured that no damage was done to the outer casing. The new ProMILL Duo technology was run and completed 111 ft of 9⅝ inch casing in one run, which was followed by 100 ft of hole enlargement to open the hole to 13.5 inches diameter. The cement job was completed and the objective of restoring the cap rock seal across two strings of casing was achieved.

The new ProMILL Duo Dual Casing section milling technology provided the planning engineer an efficient way to achieve a rock-to-rock seal across the 7 inch and 9⅝ inch casings, that resulted in saving at least 40 days of rig time when compared to conventional plug and abandonment solutions.

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8000 ProMill Duo* Completes Three Back-to-Back Windows on One Well in Qatar

Barrier restoration across 9⅝ and 13⅜ inch casings achieved successfully.

CHALLENGE

Section mill 13⅜ inch casing to restore three cap rock barriers across 9⅝ inch and 13⅜ inch casings.

SOLUTION

Deploy 8000 series ProMill Duo to drift through 9⅝ inch casing and section mill 13⅜ inch casing.

RESULTS

- Successfully drifted 9⅝ inch casing and section milled 13⅜ inch casing to restore three cap rock barriers.
- No BHAs stuck or lost in hole incidents.
- Reduced the AFE cost for the project by eliminating a long inner string milling operation, associated with conventional techniques.
- All operations conducted safely.

Dual casing section milling 9⅝ inch and 13⅜ inch casing

When cap rock sealing restoration across two casing strings, 9⅝ inch and 13⅜ inch was required for three separate cap rocks, the customer contacted Wellbore Integrity Solutions (WIS). The challenge was to mill the inner 9⅝ inch casing, that is cemented to the surface, without skimming the outer 13⅜ inch casing and then mill the 13⅜ inch casing by drifting through the 9⅝ inch casing with minimum trips when compared to conventional methods. WIS recommended the new ProMill Duo high ratio section milling system that enables a rock to rock seal in a dual casing section milling application.

Challenges conquered by ProMILL Duo technology

Operational challenges were decoupled using both the standard section mill and the new ProMill Duo technology. The ProMill Duo is a combination of the newly engineered high-ratio hydraulic section mill, with a 180% expansion ratio and a precisely oriented hydraulic stabilizer below it. This creates a unique 6-point stabilization system that helps to manage the dynamic behavior during milling. The ProMill Duo is deployed once the inner 9⅝ inch casing window has been milled. The expandable stabilizer in the system ensures that the section milling assembly can efficiently mill the 13⅜ inch casing. An underreamer is utilized to achieve a 20 inches diameter window to enable a rock to rock seal.

Section Milling Efficiency Results

8000 ProMill Duo	Depth In (ft)	Depth Out (ft)	Total Interval (ft)	Wear (%)	Rig Time Saving (days)
Plug #1	3750	3860	110	20	3
Plug #2, Run # 1	2850	2885	35	100	1
Plug #2, Run # 2	2890	2955	65	30	1
Plug # 3, Run # 1	1885	1950	65	40	3

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Wellbore Integrity SOLUTIONS

Successful Execution of a Challenging Dual Completion Fishing Operation in the UAE

Experienced Wellbore Integrity Solutions (WIS) personnel planned and recovered a severely corroded dual completion.

CHALLENGE

A dual completion recovery operation was required by the customer, in a well with a complex downhole condition such as restricted wireline access to the tubing ID, severely corroded tubing, and collapsed liner in multiple sections. A contingency plan for well abandonment was considered by the customer due to the operational complexities.

SOLUTION

WIS provided experienced personnel to plan and efficiently execute the operation. Equipment, positioned locally, was utilized to ensure operational continuity. Extensive planning and technical analyses were done on BHA options and contingencies.

RESULTS

- 100% recovery of the old completion tubing and accessories was achieved.
- Comprehensive planning and experience were combined to ensure a successful operation.
- The customer was able to restore valuable well production.
- Formal recognition of outstanding performance was provided to WIS.

A complex dual completion recovery was completed and exceeded customer expectations.

The WIS team in the UAE planned and executed a challenging dual completion recovery, comprising of 2⅞ in. and 3½ in. tubing with both HS and GT hydraulic packers. During the planning process, several key factors were identified that increased the complexity of the operation:

- No internal access for wireline operations.
- Heavily corroded tubing.
- The liner was collapsed at intermittent sections.
- Multiple unrecorded obstructions in the wellbore.
- The well was at a 65-degree inclination with 7-10 degree dogleg severity (DLS).

The planning process included BHA optimization, to minimize stuck scenarios. Contingency plans were also considered for all phases of the operation. The presence of unrecorded obstructions in the wellbore also required flexibility in the wellsite execution process.

Equipment and personnel were mobilized from a WIS base to ensure prompt service and support for the customer. Close collaboration with the customer was maintained at all times to ensure the operation was completed successfully.

Figure 1: Recovered corroded tubing.

Figure 2: Recovered HS packer.

Figure 3: Corroded tubing junk recovered.

Figure 4: Recovered wireline tools previously lost in hole without any records.

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Wellbore Integrity SOLUTIONS

An Outstanding Open Hole, Horizontal Washover and Fishing Operation, Under Total Losses, Results in the Recovery of an RSS BHA

The WIS team in Kuwait successfully planned and recovered a BHA valued at $2 million and avoided a sidetrack requirement.

CHALLENGE

A customer required the retrieval of a stuck 8.5 inch RSS BHA in a horizontal section, with well under total losses.

SOLUTION

WIS evaluated and proposed a washover and retrieval solution that successfully freed the stuck BHA safely on the first attempt after washing over. Downhole energy was maximized at the stuck point by using the TMC jar and accelerator. Experienced WIS personnel were also essential in ensuring the success of this operation.

RESULT

- A successful washover of the stuck BHA in the horizontal section was completed, under a condition of total fluid losses.
- The stuck BHA was retrieved at the first attempt using the TMC Impact System, in an open hole while the well was under total losses.
- The customer saved 2 million dollars in potential Lost-In-Hole (LIH) charges.
- The customer avoided significant sidetrack costs that would have been incurred.

The WIS team demonstrated efficient planning and execution of a complex open hole wash over and retrieval operation to recover a stuck 8.5 inch RSS directional drilling BHA in a lateral hole section.

A major customer in Kuwait contacted WIS to provide a unique fishing solution when faced with the challenge of retrieving a stuck BHA in 8.5 inch open hole. The risks associated with this operation was further compounded as the well was under total losses.

WIS responded with a detailed plan and risk assessment that was reviewed and accepted by the customer. Experienced WIS personnel and equipment were then mobilized from the local support base. As part of the equipment package, a TMC Impact System, comprising both jar and accelerator, was included to maximize downhole energy at the stuck point.

The plan was executed with precision, WIS washed over the 129.88 ft of stuck 8.5 inch RSS BHA at a depth of 6550 ft and later retrieved the entire fish from the open hole, meeting the objective of the operation and saving the customer 2 million USD.

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Sidetracking Success Using the TrackMaster Select System in India

Four consecutive sidetracks from 13 3/8 inch casing were planned and executed flawlessly by the Wellbore Integrity Solutions (WIS) team in India.

CHALLENGE

The customer required four consecutive wells to be sidetracked from 13 3/8 inch casing. The casing was uncemented adding complexity to the application and increasing the risk of achieving a successful window in a single trip.

SOLUTION

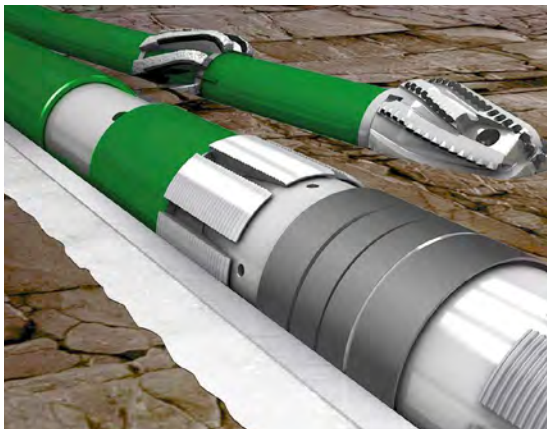
WIS completed a thorough planning process and recommended the deployment of the TrackMaster Select* system. A local team of experienced personnel were also instrumental in ensuring that all four sidetracks were completed successfully.

RESULT

- Each TrackMaster Select system was set at the desired depth, the windows were milled, and rat hole drilled all in a single trip.
- At the surface, all mills were determined to be within wear tolerances, confirming a full gauge, high-quality window.
- The subsequent directional drilling bottom hole assemblies (BHAs) passed through the milled windows without issue.

Emphasis on planning, risk assessment, and local experience were key factors in delivering sidetracking success in an offshore application.

A customer in India required four consecutive wells to be sidetracked from the 13 3/8 inch casing section. From a planning and risk assessment perspective, the casing was known to be uncemented and therefore carried a higher risk of single trip success and window quality. The WIS team in India recommended the use of the TrackMaster Select system with a fit-for-purpose milling configuration. Detailed pre-job planning for both crew and equipment was conducted with continuous 24-hour support from the WIS support base in Mumbai during operational execution. Close collaboration was maintained with the customer at all times. All four sidetracks were performed as intended, in one trip with a full gauge high-quality window.



TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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Wellbore Integrity SOLUTIONS

Deepest 9⅝ inch Section Milling Job Completed by Wellbore Integrity Solutions

Successfully section milled, in Qatar, 97 ft of 53.5 ppf, L-80 casing at 73 degree inclination using 8200 series K-Master* section mill knives dressed with WavEdge* ridged milling element.

CHALLENGE

As per the plug and abandon scope of work the customer in Qatar required to section mill 110 ft of 9⅝ in., 53.5 ppf, L–80 casing from 15747 to 15867 ft at a 73 deg wellbore inclination enabling a successful rock-to-rock seal of the cap rock.

SOLUTION

8200 K-Master section mill with knives dressed with WavEdge* ridged milling element.

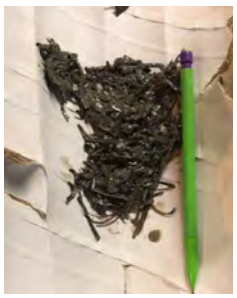
RESULT

- Successfully section milled the 9⅝ in. casing
- New frontier conquered, deepest section milling job in MENA milling heavy walled 53.5 ppf casing
- Successfully section milled in a highly deviated wellbore at 73 degree hole angle, with minimal knives wear

Wellbore Integrity Solutions delivering technological innovation to our customers.

Unique technical solution delivered to the customer in Qatar.

Section milled 9⅝ inch, 53.5 ppf, L-80 casing from 15747 to 15867.7 ft where the wellbore inclination was 73 degrees. The 8200 K-Master section mill successfully completed the window dressed with WavEdge* elements. The wear on the knives was less than 10% for a highly deviated well. This newly designed milling element has improved durability through enhanced milling stabilization and provided improved swarf quality, allowing better hole cleaning. The optimized swarf size also allowed better swarf management at the surface flow lines.



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Wellbore Integrity SOLUTIONS

9⅝ inch TrackMaster Elite* sets the benchmark in sidetracking precision at an offshore well in Qatar

Wellbore Integrity Solutions provides longer window and lower dogleg severity (DLS) achieves customer objectives without torque or drag.

CHALLENGE

The customer in Qatar required a low dogleg severity (DLS) sidetrack across the whipstock through 9 ⅝ in. 40 ppf L-80 casing on one of their offshore wells that would enable them to drill the long horizontal section . High DLS across the window would limit the total depth (TD) of the horizontal section due to the high surface torque at TD thus reducing production from this well.

SOLUTION

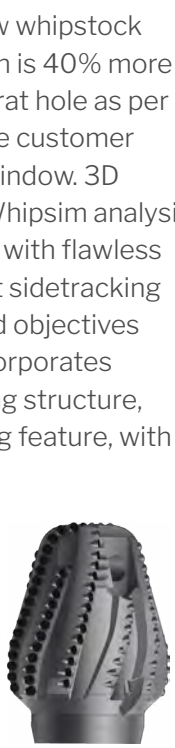
Wellbore Integrity Solutions recommended the 9⅝ in. TrackMaster Elite whipstock to sidetrack the wellbore, this technology would provide a longer window, 40% more than a standard TrackMaster whipstock, while providing a full gauge window avoiding multiple trips and clean out runs in the process.

RESULT

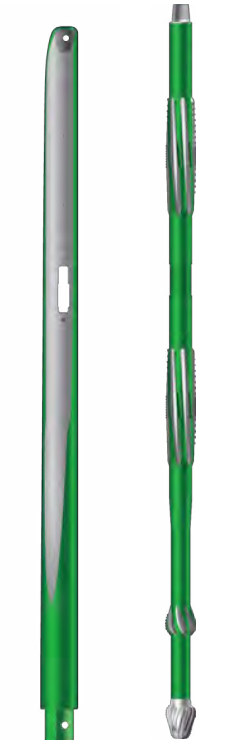
- The 9 ⅝ in. 40 ppf L-80 casing was sidetracked in one run.
- The quad-mill assembly was within an acceptable gauge with the lead mill 3⁄16 in., follow mill 3⁄16 in., dress mill ⅛ in., and elite watermelon mill in gauge.
- Directional assembly passed the window without any obstructions.
- The horizontal section BHA drilled to TD at 22,000 ft without any torque limitations thus achieving the objective of the well design.

Wellbore Integrity Solutions, Qatar in collaboration with the customer successfully sidetracked the 9 ⅝ inch 40 ppf L-80 casing in the lateral hole section.

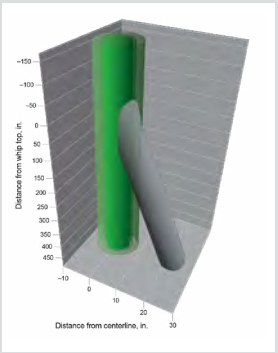
The TrackMaster Elite extended window whipstock system milled 22.125 ft of window which is 40% more than a standard window and drilled the rat hole as per operator requirements. This enabled the customer to avoid multiple trips to elongate the window. 3D window profiling was achieved by the Whipsim analysis model. Excellent pre-job planning along with flawless execution of the operation ensured that sidetracking was achieved per the operators planned objectives for production. The Elite whipstock incorporates an improved lead mill with denser cutting structure, optimized design and upgraded cleaning feature, with additional nozzles.

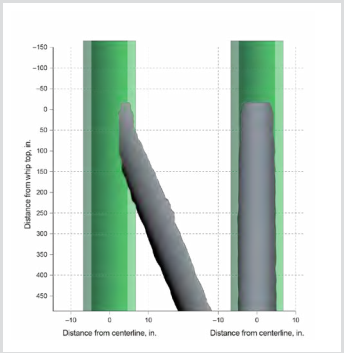


Mill head



Elongated whipstock *Quad-mill*





Milling systems designed and modeled with the WhipSim software ensure smooth casing exits and help minimize kickoff DLS.

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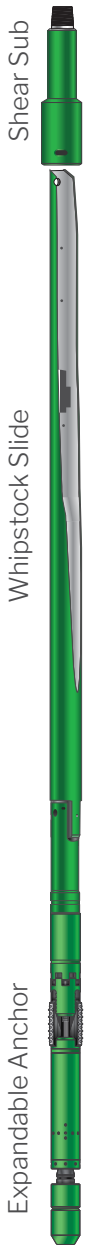
Protect People.
Protect the Environment.

NORTH AMERICA

Wellbore Integrity SOLUTIONS

Major Permian Basin Operator achieved a Record-Setting Lateral Sidetracking Operation Using the TrackMaster* Select-OH Whipstock System

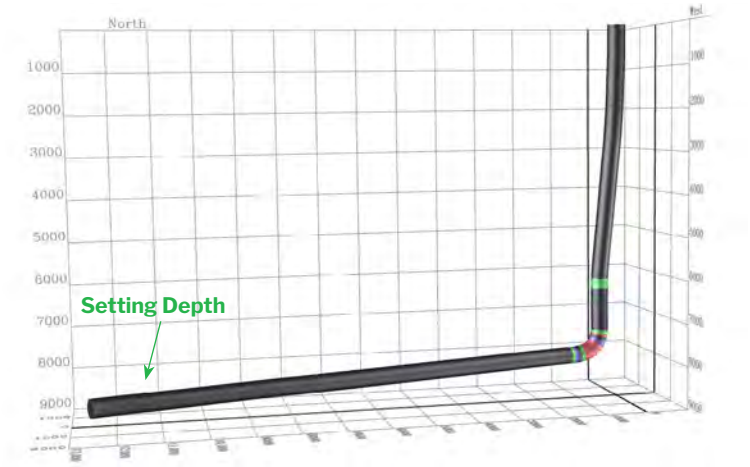
Wellbore Integrity Solutions (WIS) successfully planned and executed a 6¾ inch open hole sidetrack located at 9,750 ft in the lateral section with TrackMaster Select Whipstock setting depth at 18,675 ft measured depth (MD) in the Permian Basin.



Flawlessly executed open hole lateral sidetrack.

A prominent operator in the Permian Basin collaborated with the WIS Red Baron wellbore departure team for an expert solution to sidetrack in a 6¾ inch lateral with the top of fish located at 20,759 ft MD. WIS recommended a 7⅝ inch TrackMaster OH System with hydraulic anchor conveyed on a shear sub to achieve the wellbore departure sidetracking objectives. The implementation of the shear sub sub-assembly presents a technical solution for deploying the whipstock through intricate wellbore sections without premature fatiguing of the break bolt. This is achieved by applying direct force between the shear sub and whipstock assembly, ensuring that the shear screw encounters load exclusively during overpull (tension) conditions.

The 7⅝ inch TrackMaster OH system with the hydraulic anchor was oriented to the desired direction using MWD and properly set at 18,675 ft MD, preserving over 9,750 ft of lateral. An optimized bi-mill kickoff assembly was used on a subsequent trip, delivering an 11 ft window plus 10 ft of rat hole. Further, tri-axial slips on the WIS hydraulic anchor are capable of opening up to 9.13 inches, providing a reliable and secure grip in case OH gauge inconsistencies are encountered. The unique design features of the WIS TrackMaster modular system were instrumental in getting the customer back to drilling for a successful OH lateral sidetrack around any obstacle in challenging wellbore conditions.



TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

Location: Permian Basin
Whip System Size: 7⅝ inch TrackMaster
OH Size: 6¾ inch Horizontal
KOP: 7,815 ft MD
Start of Horizontal: 8,930 ft
Sidetrack Depth: 18,654 ft MD
DLS @ Whipstock: 0.25° /100 ft
Max Pass Through DLS: 12.9° /100 ft
Inclination @ Whipstock: 90°

CHALLENGE

- Deliver a 6¾ inch open hole sidetrack at an unprecedented depth located 9,725 ft into the horizontal section.
- An ability to travel with a whipstock system through a curved section with high DLS due to irretrievable fish in an existing wellbore.

SOLUTION

- Select the 7⅝ inch OH TrackMaster Modular Whipstock with shear sub system and hydraulic anchor.
- Use of the shear sub system to allow slack-off weight to be applied without fatiguing the shear bolt due to challenging OH wellbore conditions.
- Evaluate well trajectory and propose specific orientation at the desired direction at a setting depth of 18,675 ft MD.

RESULTS

- Delivered a new record with the deepest open hole lateral sidetrack using a whipstock around an irretrievable fish in the wellbore.
- Preserved over 9,725 ft of lateral sidetracking, eliminating extra time and expenditures for a re-drill.
- Achieved wellbore departure objectives by delivering an 11 ft window plus 10 ft of rat hole.
- Optimized mill cutting structure to match OH formation characteristics.
- Reliable sidetracking method with a known kickoff point reduced risk and uncertainly of alternative sidetracking methods.

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Wellbore Integrity SOLUTIONS

An Outstanding, High DLS, Cased Hole Exit Success in West Texas

Wellbore Integrity Solutions (WIS) successfully set a 9⅝ inch TrackMaster Select* system for UpCurve Energy, in a high DLS wellbore, saving 600 feet or 75% of the previously drilled curve section.

CHALLENGE

Set a cased hole whipstock system in a single trip within a high DLS wellbore to recover a previously drilled curve section.

SOLUTION

- Utilize the TrackMaster Select whipstock sidetracking system, conveyed with a 8½ inch bi-mill.
- Establish suitable operational procedures for the high DLS environment and ensure that operational risks are mitigated.

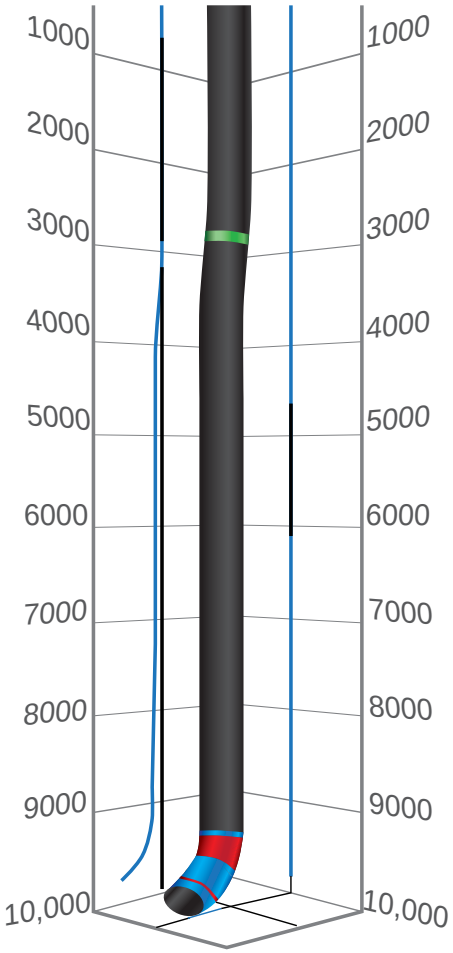
RESULTS

- The system was conveyed successfully through a DLS of greater than 10 deg/100 ft.
- The system was set successfully in the curve at 9,692 ft depth, with an inclination of 46 deg and a 6.74 deg /100 ft DLS at the setting depth.
- The window was milled and the rathole drilled in a single trip, in 12 hours.
- UpCurve Energy successfully drilled and landed the curve and continued to drill the wellbore to the desired target depth.

An unplanned sidetrack, around a fish in the wellbore, recovers the previously drilled wellbore.

WIS collaborated closely with the customer, UpCurve Energy ,to plan and execute a successful TrackMaster Select cased hole whipstock job in Reeves County, TX. The TrackMaster system was conveyed through a high dogleg of 10.09 deg / 100 ft to reach the setting depth of 9,692 ft MD. Using the system's hydraulic anchoring system, the customer was able to choose a precise setting depth position for the top of the whipstock. Proper orientation helped to mill 16 feet of window and 6 feet of formation. The operation was completed in a single trip, in a total of 12 hours.

The customer representative recognized the value of this sidetrack operation. The ability to convey and set the system in a high DLS scenario was a known technical challenge. This successful sidetrack allowed the client to avoid redrilling the entire curve and continue drilling the lateral section to TD.



Well path profile simulation.
DLS: Green > 2.5
Blue > 5.0
Red > 7.6

TrackMaster Select™

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- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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An Outstanding Open Hole Sidetracking Performance in the Permian Basin using the TrackMaster OH System

After two unsuccessful sidetrack attempts, a customer in the Permian Basin mobilized WIS to set a 10¾ inch TrackMaster OH whipstock and drill the rathole. The operation was completed in one-trip in a total of 16 hours.

CHALLENGE

A customer required a sidetrack, around a fish at 1,300 feet measured depth in a wellbore with complete fluid losses. An alternative whipstock provider had twice attempted, unsuccessfully to conduct the sidetrack.

SOLUTION

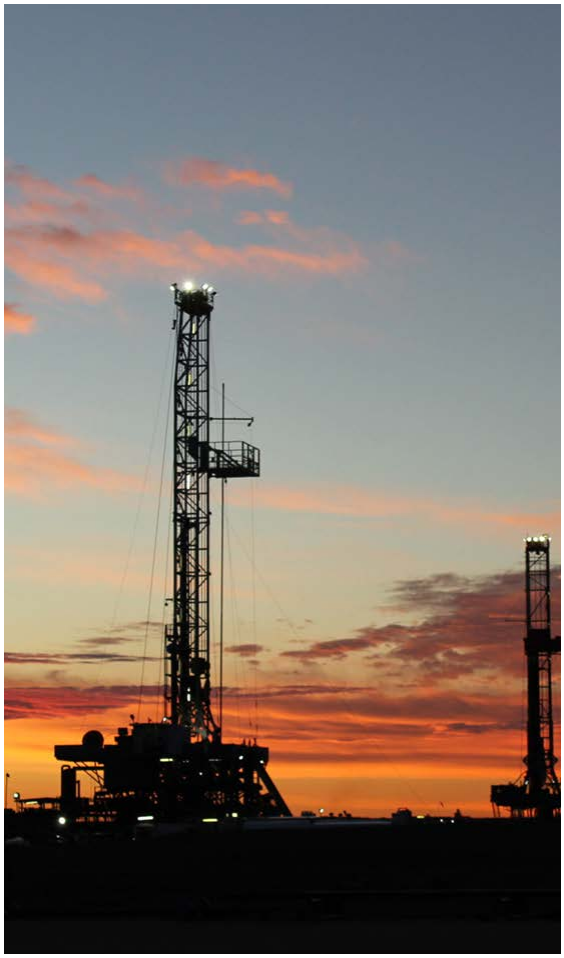
A 10¾ inch Open Hole sidetrack using a TrackMaster system with a hydraulic, expandable anchor was planned and quickly mobilized, along with experienced WIS personnel. A successful sidetrack was conducted efficiently and in a single strip at the first attempt.

RESULTS

- Sidetracking success in one trip in challenging total fluid losses zone.
- The sidetrack was completed in 16 hours, surface to surface.
- The sidetracking time included 23 feet of 9⅞ inch rathole.
- The TrackMaster system was set just above the fish, maximizing wellbore recovery.

Experience and performance reliability.

An open hole sidetrack, around a fish, was required in a zone with total fluid losses. An alternative whipstock provider had attempted to sidetrack twice, unsuccessfully both times. The experienced local WIS team and TrackMaster OH 10¾ inch system was mobilized to the well site. The TrackMaster OH was conveyed and set at the desired depth and 23 feet of 9⅞ inch rathole was drilled in a single trip in a total of 16 hours, surface-to-surface.



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TrackMaster-OH Open Hole Whipstock System Solves Sidetracking Challenge in South Texas

After three failed attempts to sidetrack with cement plugs, the TrackMaster Open Hole (OH) whipstock with bi-mill provided a reliable and defined kick-off point in less than 20 hours.

CHALLENGE

A customer required a reliable solution to conduct an open hole sidetrack. Ten days of lost time had been experienced while attempting to sidetrack off cement plugs. Preservation of the drilling plan by providing a defined, accurate kick-off point was also important.

SOLUTION

WIS proposed and deployed the single trip TrackMaster-OH Whipstock system, utilizing a bi-mill configuration to create the window and drill the rathole. Experienced WIS field personnel were also mobilized to the well site to ensure a successful sidetrack operation.

RESULTS

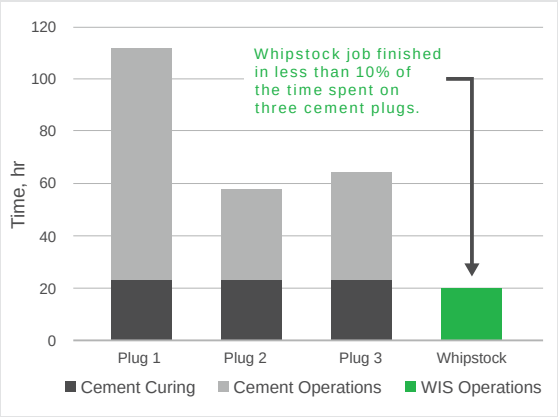
- The TrackMaster-OH whipstock system, was set, created the window, and drilled the rathole in a single trip.
- The total whipstock job time, from surface-to-surface, was completed in less than 20 hours. This equated to approximately 10% of the time spent on the previously unsuccessful sidetrack attempts from cement plugs.
- The customer then successfully continued to drill the wellbore trajectory to the desired target depth.

A reliable sidetracking solution after lost time spent on unsuccessful sidetracks from a cement plug.

WIS in South Texas successfully planned and executed a TrackMaster-OH* whipstock job where challenges were encountered to sidetrack using conventional cement plug methods. After three unsuccessful attempts to kick-off cement plugs over a period of ten days, WIS successfully mobilized, deployed, and set a TrackMaster-OH whipstock system and drilled 19 ft of rathole in 20 hours. The customer was able to successfully recover the planned wellbore direction due to the whipstock's defined kick-off depth.

TrackMaster bi-mill opens 19 ft of full-gauge window and rathole in 4.3 hours.

A bi-mill configuration with the TrackMaster-OH hydraulic whipstock was used to provide a reliable one-trip system, capable of setting the whipstock and milling the rathole in a single trip. The bi-mill, dressed with both PDC and tungsten carbide inserts, delivered a full-gauge rathole to TD. The subsequent directional drilling BHA passed through the whipstock window and successfully drilled the curve to the target depth.



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Deployment of TrackMaster-OH Whipstock Recovers 8,300 ft of Horizontal Wellbore in the Permian Basin

WIS successfully set an open hole whipstock 8,350ft into a 6¾ inch lateral section, for a total depth of almost 18,000 ft.

CHALLENGE

A customer required an unplanned sidetrack in an extended reach open hole lateral hole section. Placing the whipstock as close to the fish as possible in the lateral section would eliminate a costly re-drill operation for the customer. A whipstock setting depth of approximately 18,000 ft was required. The anticipated torque and drag to convey and set the whipstock system to the desired depth was also considered to be a significant operational risk.

SOLUTION

WIS deployed its field-proven TrackMaster-OH hydraulic whipstock system with an expandable anchor for this application. A shear sub conveyance method was also used to ensure secure deployment to the desired depth and orientation. WIS personnel, with direct experience in open hole lateral whipstock applications, were also utilized to ensure operational success.

RESULTS

- The TrackMaster-OH system was successfully deployed, oriented, and set at 17,950 ft MD in accordance with the customer expectations
- This successful operation saved 98% of the existing lateral open hole section, totaling 8,350 ft.
- The customer saved an estimated five days of rig time by the avoidance of re-drilling this hole section.

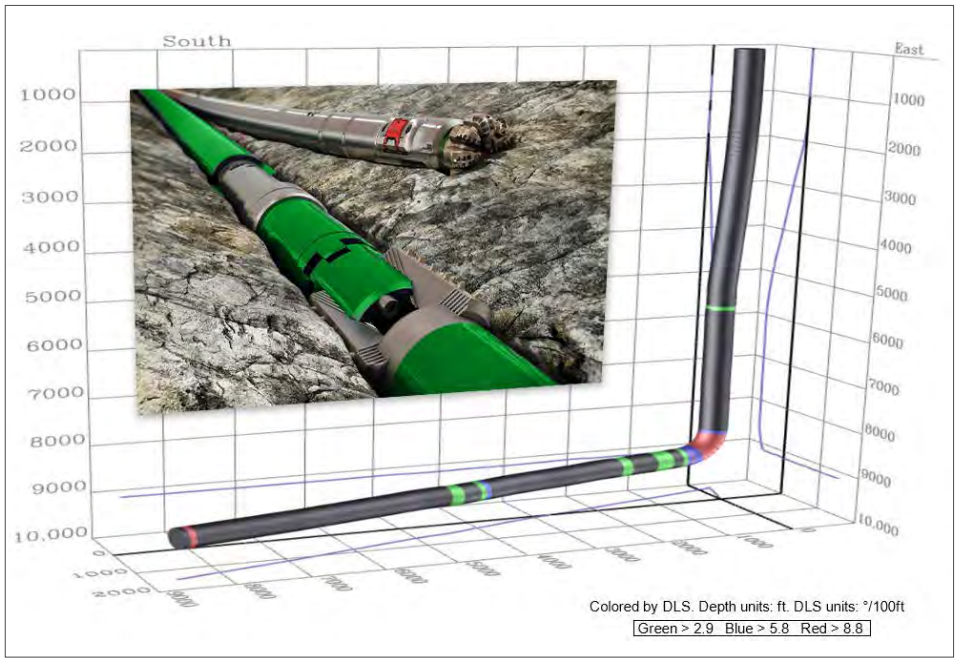
Excellence is achieved in a challenging open hole sidetrack.

An unplanned sidetrack in an extended reach lateral wellbore was required. WIS deployed the TrackMaster-OH* whipstock system at short notice and set it in the 6¾ inch diameter open hole formation, 9,270 ft past the top of the curve, for a total measured depth of 17,950 ft. Although WIS has completed numerous whipstock jobs in lateral sections, this application presented new challenges with a high Dog Leg Severity (DLS), and extended lateral length.

TrackMaster-OH system deployment with a shear sub.

As part of the planning and risk assessment process, the TrackMaster-OH was conveyed using a shear sub. This configuration is ideally suited for tortuous, deviated, lateral wellbores where traditional mill-to-whip systems cannot be utilized. Using a shear sub provided the ability to push through tight spots without risking the premature shear of the whipstock. This feature offers an important advantage when performing open hole sidetracks in long laterals.

The expandable anchor, with its wide opening diameter range and reliable hydraulic activation system, was also selected to securely anchor the system.



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A Rapid Solution that Enables a Successful Sidetrack from an 18 inch Casing in the Gulf of Mexico

Wellbore Integrity Solutions (WIS) engineering, manufacturing, and operational teams successfully collaborated on deploying a TrackMaster Select* System to sidetrack from 18 in., 117 lbm/ft, P-110 casing resulting in the recovery of the 16.5 in. hole section.

CHALLENGE

The customer required a technical feasibility plan and urgent mobilization of equipment to create a window and sidetrack from 18 in., 117 lbm/ft, grade P-110 casing. A full gauge, high-quality window was required to ensure that the subsequent RSS BHA and 16 in. 109 lbm/ft, Q-125 liner could be passed through the window freely.

SOLUTION

WIS applied comprehensive engineering analysis and mobilized operational resources on short notice to optimize the planning and execution of a sidetrack operation. WhipSim simulation was used in the planning process, and the TrackMaster Select hydraulic whipstock system was used to exit the casing successfully.

RESULTS

- A successful sidetrack operation utilizing team collaboration for planning, deployment, and execution.
- A urgent mobilization timeframe was met.
- A 28 ft long window was milled and 15 ft of rathole drilled.
- Subsequent drilling BHA and liner assemblies were deployed without issues.
- A 16.5 in. hole section was recovered for the customer.

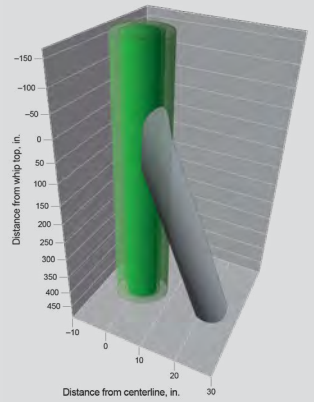
A collaborative, customer-focused approach delivers a successful sidetrack.

A customer, drilling in the Gulf of Mexico's Mississippi Canyon, encountered unexpected issues while running the 16 in., 109 lbm/ft liner. WIS was contacted to perform a sidetrack from the 18 in., 117 lbm/ft casing string, allowing recovery of the 16.5 in. hole section. Operational job planning, simulation, and technical analysis were completed promptly to deliver an optimum solution on short notice.

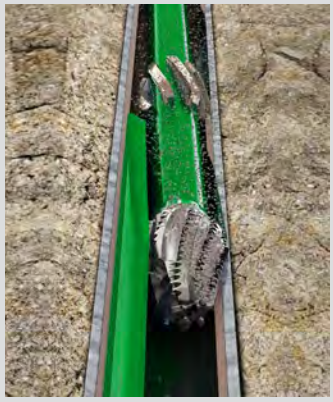
WhipSim* whipstock simulation software was used to model the whipstock setting, casing exit, and bending stresses on the subsequent BHA and liner operations. The WhipSim calculations also assisted in metal recovery planning, expected to be 2,000 lbs, on the downhole magnets. Effective metal recovery extends the life of downhole tools and wellbore components.

The TrackMaster Select* hydraulic whipstock system with an Expandable Anchor was deployed, oriented, and set successfully. A 28 ft long window and 15 ft of rathole were completed in a total of 10.3 hours. Additional clean-out runs were planned with the customer to ensure a full-gauge 16.5 in. usable window to prepare for subsequent operations.

The Rotary Steerable System (RSS) BHA and liner conveyance operations continued without issues, allowing the operator to avoid the costly and time-consuming requirement of re-drilling the hole section.



WhipSim whipstock simulation software example.*



TrackMaster Select

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Deliver Results

We strive to provide superior products and solutions that drive results for customers..

RUSSIA AND CENTRAL ASIA

Creative Fishing Solutions Restores Well Production in Kazakhstan

Wellbore Integrity Solutions' (WIS) Red Baron fishing and remedial services successfully completed a complex workover in a valuable, producing well.

Operational planning and local experience delivers success.

A complex workover operation for a customer in Kazakhstan was completed successfully by the local WIS team. To complete this operation, several innovative solutions were required. Specific procedures were developed and risks were assessed in close co-operation with the customer. A valuable, producing well was subsequently restored.

Considerations:

- After several attempts a 7 inch Hydraulic Packer could not be recovered conventionally.
- Debris in the wellbore was considered to increase operational risks, in terms of both high torque and increased likelihood of stuck pipe.
- The condition of the production tubing and the specifications of the early electrical submersible pump (ESP) cable also increased operational risk in terms of recovery.

As part of the solutions provided, a modified Rope Spear and a Custom Junk Basket with spring tines was designed and manufactured at the WIS local base on an urgent basis. These customized solutions were key items that enabled the recovery of 800m of ESP cable. A mechanical backoff with a Left Hand (LH) Die Collar BHA recovered the production tubing and allowed access to the Hydraulic Packer. The Hydraulic Packer was then milled and retrieved.

A successful, challenging workover was concluded with customer recognition of WIS performance and support.

A customized Junk Basket with spring tines effectively recovers the ESP cable.

CHALLENGE

A valuable, producing well was at risk of being lost after unsuccessful attempts to release the 7 inch hydraulic set packer. The complexity of the planned workover was also increased by the condition of the production tubing and the ESP cable.

SOLUTION

- A modified Rope Spear and a custom designed Junk Basket was manufactured locally at short notice. These items were important in the recovery of the ESP cable
- A mechanical backoff with a LH Die Collar retrieved the production tubing
- The 7 inch hydraulic packer was subsequently milled and retrieved

RESULTS

- Retrieved 450m of ESP cable with a modified rope spear
- Retrieved 350m of ESP cable with a custom designed and manufactured Junk Basket
- Retrieved 84 joints of production tubing with the LH Die Collar
- Milled and retrieved the 7 inch hydraulic packer
- Completed the project to the customer's satisfaction

Wellbore Integrity SOLUTIONS

First TrackMaster Select Whipstock Set for Dual Casing Exit Offshore in Azerbaijan

Wellbore Integrity Solutions (WIS) delivered a full-gauge window in a challenging environment.

Proper planning leads to flawless job execution.

Azerbaijan State Oil Company (SOCAR) was looking to perform the dual casing window exit through poorly cemented strings of 6 5⁄8 inch x 9 5⁄8 inch casings.

WIS proposed and planned the use of the TrackMaster Select* Cased Hole System for this challenging project. All well data, including CCL and CBL logs, were gathered and analyzed. Whipstock simulations were run in WhipSim* software to obtain the best setting depth and operating parameters.

Primary and backup TrackMaster Select systems were sourced and prepared to fulfill all operational needs. As a result of the collaborative work, the full-gauge window was completed in two runs. The first run took 3.5 hours to mill the window and 1.5 hours to drill a rathole. A second run was performed to dress the window and verify proper hole cleaning. After pulling out the hole with the drift BHA, all the mills were in-gauge. The subsequent BHA was run and drilled to total depth with no issues.

Left: Whipstock assembly just before the run in the hole. Middle: Tri-mill assembly for the drift run just before the run in the hole. Right: In-gauge mills after the drift run.

CHALLENGE

To mill a full-gauge window and drill rathole through 6 5⁄8 inch x 9 5⁄8 inch casings.

SOLUTION

- Use the TrackMaster Select* System for Cased Hole applications to achieve a high-quality window for passing the subsequent drilling BHA
- Adjust parameters to minimize shock and vibration while milling a window in poorly cemented casing strings
- WhipSim* software used for whipstock simulation to achieve optimal performance

RESULTS

- Successfully completed full-gauge dual casing window and drilled 5 m of rathole
- Subsequent drilling BHA passed the window and reached total depth with no issues
- Zero NPT
- The customer was very satisfied with the job performance

TrackMaster Select™

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- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

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Wellbore Integrity SOLUTIONS

The TrackMaster Select* System Enables Reservoir Access in an Extended Reach, High Angle Well

Wellbore Integrity Solutions' (WIS) Red Baron experts completed the milling of a full-gauge window on an Extended Reach Drilling (ERD) well.

Ultra deep-cased hole sidetrack performed with the TrackMaster Select System

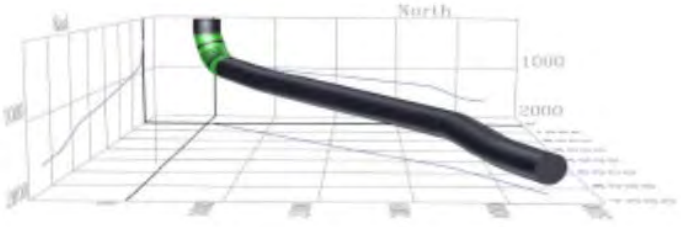
An operator planned to perform an ultra deep-cased hole sidetrack to access a new reservoir. The TrackMaster Select System was chosen to mill the window and drill the rathole for the subsequent drilling BHA.

Simulation software is key for successful pre-job planning

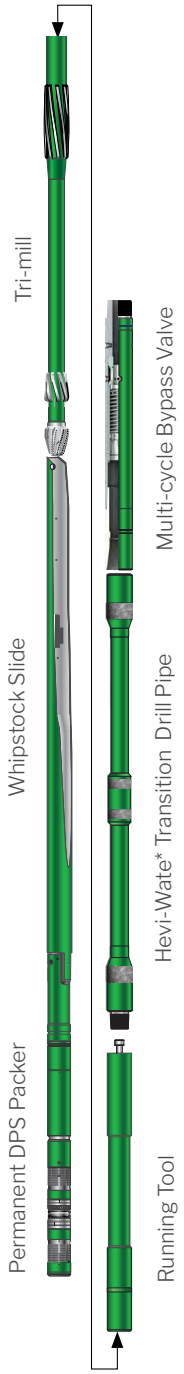
ERD wells may incur challenges such as high tensile and torsional loads, which is critical to evaluate for sidetrack operations. Risks were minimized by using the whipstock simulation software WhipSim* and Runner* torque and drag evaluation software. An optimal BHA was proposed to avoid buckling while tripping, which could fatigue the shear bolt and inhibit milling operations.

TrackMaster Select delivers a full-gauge window in an ERD well

The pre-determined BHA was run in the hole, the whipstock was set at 6350 m, and the break bolt was successfully sheared. A full-gauge window and rathole was milled in one trip allowing the subsequent BHA to pass through with no issues.



Well path trajectory from Runner for the Sidetrack at 6350 m



CHALLENGE

The WIS Red Baron team was asked to mill a full-gauge window in 9⅝ inch 40 lbm/ft casing and drill a 3.5 m rathole at 6350 m meaursed depth with a 85° inclination to access a new reservior.

SOLUTION

The 9⅝ inch casing TrackMaster Select System for the cased hole was supplied. Its configuration with the 8 ½ inch OD tri-mill was designed for milling a full-gauge window and drilling a rathole of the required length in a single trip.

RESULTS

- A high-quality window was created in the horizontal section
- Zero hours of non-productive time (NPT) reported
- Subsequent BHA passed the window with no drag

TrackMaster Select™

- A HISTORY OF INNOVATION
- UNRIVALED EXPERIENCE
- GLOBAL PRESENCE

wellboreintegrity.com

Mission — Vision — Values — Behaviors

OUR MISSION

Create a people centric company delivering profitability, growth, and a greener future focusing on superior technology, value, and service quality for our customers.

OUR VISION

To be recognized globally, focused on innovative solutions to increase asset value, operational efficiency, and reduce environmental risk for all our futures.

OUR VALUES

Well-Being and Environmental Stewardship

Protect our people; preserve the communities and environments where we work.

Guiding Behaviors:

- Safety and respect for the environment guides all our decisions
- Support work life harmony
- Mental health is as important as physical
- Everyone is responsible and accountable to act safely and look after others

Trust and Teamwork

Conduct business with transparency, inclusivity, and trust.

Guiding Behaviors:

- Build diverse teams; respect different viewpoints
- Be transparent and inclusive in open/honest communication
- Everyone has a voice
- Encourage collaboration; share ideas, lessons learned, information and seeks help and to help others

Customer Focus

Strive to exceed customer expectations.

Guiding Behaviors:

- Understand customers needs, requirements and values
- Take ownership and accountability to address problems and opportunities
- Collaborate with customers and understand everyone has a role in providing the best solution
- Strategic thinking

Deliver Results

Drive financial performance for WIS stakeholders and customers.

Guiding Behaviors:

- Deliver quality products and customer services
- Be cost and profitability conscious for all products and services delivered
- Focus on maximizing asset value for customers while reducing risk and/or time
- Focus on training and development

Enterprising

Be open and receptive to creative thinking.

Guiding Behaviors:

- Welcome new ideas, opportunities, and ways of working
- Reward entrepreneurial thinking and endeavors
- Challenge each other to stretch beyond the norm
- Employees are empowered and supported to step out of their comfort zones

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