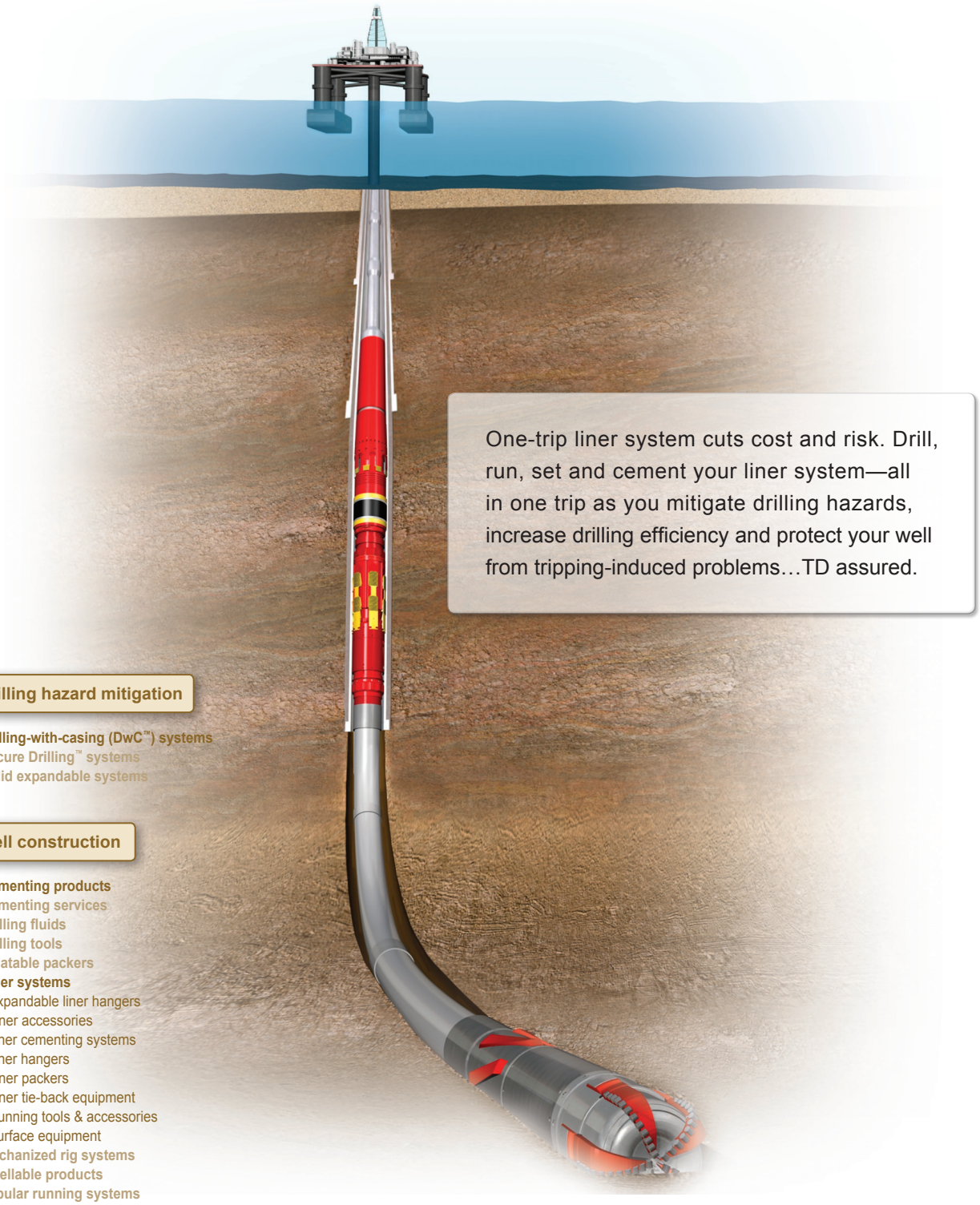
Weatherford®

Drilling-with-Liner (DwL™) System

Drill the Undrillable



One-trip liner system cuts cost and risk. Drill, run, set and cement your liner system—all in one trip as you mitigate drilling hazards, increase drilling efficiency and protect your well from tripping-induced problems…TD assured.

Drilling

Evaluation

Completion

Production

Intervention

Drilling hazard mitigation

- Drilling-with-casing (DwC™) systems
- Secure Drilling™ systems
- Solid expandable systems

Well construction

- Cementing products
- Cementing services
- Drilling fluids
- Drilling tools
- Inflatable packers
- Liner systems
  - Expandable liner hangers
  - Liner accessories
  - Liner cementing systems
  - Liner hangers
  - Liner packers
  - Liner tie-back equipment
  - Running tools & accessories
  - Surface equipment
- Mechanized rig systems
- Swellable products
- Tubular running systems

Getting you through drilling hazards

Sometimes you don't have a choice about tackling drilling hazards head-on. When you have to drill through formations, zones and sections where there are risks of fluid loss, damage, breakdown, swelling, moving or abnormal pressures, Weatherford has the answer—our DwL™ system. Drill the liner in and cement it in place to get these problematic zones behind pipe in a single trip. Our complete and effective *DwL* system offers you reduced well construction costs and risk, and reduced cost of failure.

Designed expressly for getting through trouble zones that can drain your budget, escalate your costs and endanger your operation, the *DwL* system is ideal for a range of hazards:

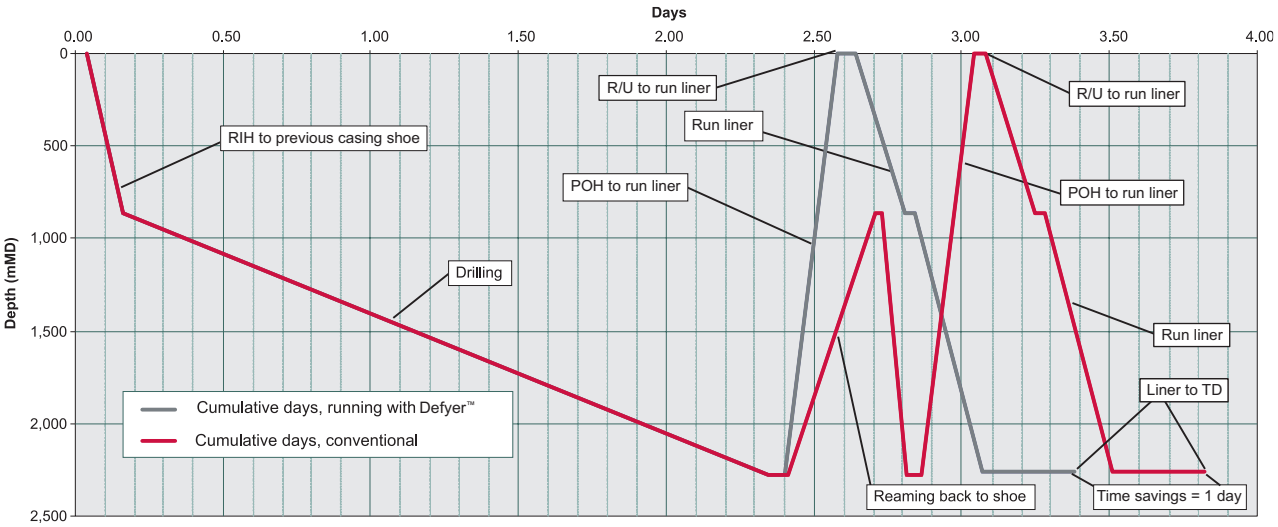
- **Depleted formations.** Drill with reduced mud weights through depleted formations, set the liner and cement normally pressured zones above them.
- **Unstable, moving or swelling formations**. Protect zones that could slough or swell, and drill or ream confidently through areas that have already sloughed. Minimize washouts induced by turbulent mud flow or wiper trips.
- **Loss zones.** Set liner and cement porous, vugular or other thief zones that can waste valuable drilling fluids.
- **Pressure zones.** In just one trip, drill and isolate gas or water flows, avoiding costly and dangerous well-control problems.
- **Salt stringers and shallow domes.** Reduce the risk of drilling through flowing salt stringers and shallow domes in one trip.
- **Problematic wells.** Ensure that the liner gets to total depth (TD) in wells with unplanned mechanical or hydraulic troubles.

Eliminating a wiper trip

Why risk running liners without the means of reaming and drilling through problems or losing part of your production zone as a result of not getting the casing to TD? Why risk losing the well? Our *DwL* system is the answer to eliminating these risks.

You can eliminate the need for wiper trips after tripping the drilling bottomhole assembly (BHA) by using *DwL* techniques to ream or drill in liner—ensuring that the string reaches target depth and is set and cemented according to well-design plans.

Even without hole problems, eliminating a wiper trip makes financial sense. After drilling a well to TD, the client may need to acquire additional reservoir and formation data by logging on wireline, while leaving the hole section open (no circulation) for more than 24 hours. After logging the common practice is to run a cleanout trip to prepare the wellbore for the liner installation. Eliminate this trip with our *DwL* system.



Our *DwL* techniques include the elimination of wiper trips—saving days of well construction costs—as well as improvement of the cement job and better long-term well integrity.

DwL™ system—complete and effective

The *application* is obvious: deploy the liner as you drill and cement it in place, casing off the trouble zones and isolating that section of your well from further problems. Proper *execution*, however, requires an integration of engineering expertise, experience and the right technologies. What you need is a true Weatherford system that benefits and adds value to your operation from the first step.

Premium liner system

- **TD assured.** The *DwL* system ensures that the liner reaches bottom, even if the hole sloughs. The system can even eliminate the wiper trip before running the liner.
- **Single-trip capability.** *DwL* technology enables the operator to drill the liner into the well across depleted or loss zones or unstable formations, set the hanger and packer, and then cement in a single trip.
- **Defyer™ series drillable casing bits.** With its fit-for-purpose, polycrystalline diamond compact (PDC) cutting structure, the *Defyer* bit converts to a drillable cementing shoe at TD. Because the *Defyer* bit is part of the *DwL* system, it does not add additional complexity to the application—instead it saves time and costs. Weatherford's *Defyer* drill bits are cost effective and simple to operate with no rig modifications required. We offer our *Defyer* tools in a wide range of sizes.
- **Liner hangers.** Weatherford's liner hangers have superb run-in features, such as large bypass areas, high-load capacities and high-torque ratings. Our hangers are hydraulically set and available in static and rotating configurations. This rotating capability is critical in achieving zonal isolation during primary cement jobs. Large slip areas distribute the load in the host casing, enabling it to support extremely heavy liners. The high-rate bypass slots enhance debris removal during well conditioning and improve cement displacement quality.
- **Liner-top packers.** Run as an integral part of the liner-hanger assembly, Weatherford's liner packers provide a protective seal between the liner OD and host-casing ID. Mechanically set with landing-string weight, this packer is used to isolate formation pressure below the liner top from the casing ID above; to isolate treating pressures below the liner top during fracture or acid work; to isolate formation fluids while the cement sets, helping to stop gas migration; and to isolate lost-circulation zones.
- **Running/setting tools.** The high-torque capability of the running tools meets or exceeds most casing threads. When picking up to make connections, the model R setting tool design prevents accidental release of the liner because of the effects of residual torque in the drillstring.

More value than conventional drilling

Although conventional drilling—running pipe, setting liners and then cementing them in place—protects your well, often this process can damage the borehole before the first joint of pipe is in the hole. Tripping in and out of the hole, wiper trips and extra circulation can often create other problems in addition to the trouble zones. Weatherford's DwL™ service improves wellbore construction relative to conventional drilling.

LoTORQ™ Centrailizer System

Reduced drilling risks

- Decreases well control incidents by limiting drillpipe tripping (swab/surge) and related hazards
- Mitigates borehole instability issues with one-trip drilling, liner-setting and cementing
- Reduces openhole risk exposure and associated drilling problems
- Requires fewer personnel on the rig floor, reducing risk exposure
- Enables running with lower mud weights
- Drills straighter holes, reducing torque, drag and cleaning problems caused by corkscrewing
- Enables drilling in underbalanced conditions

LoTAD™ System

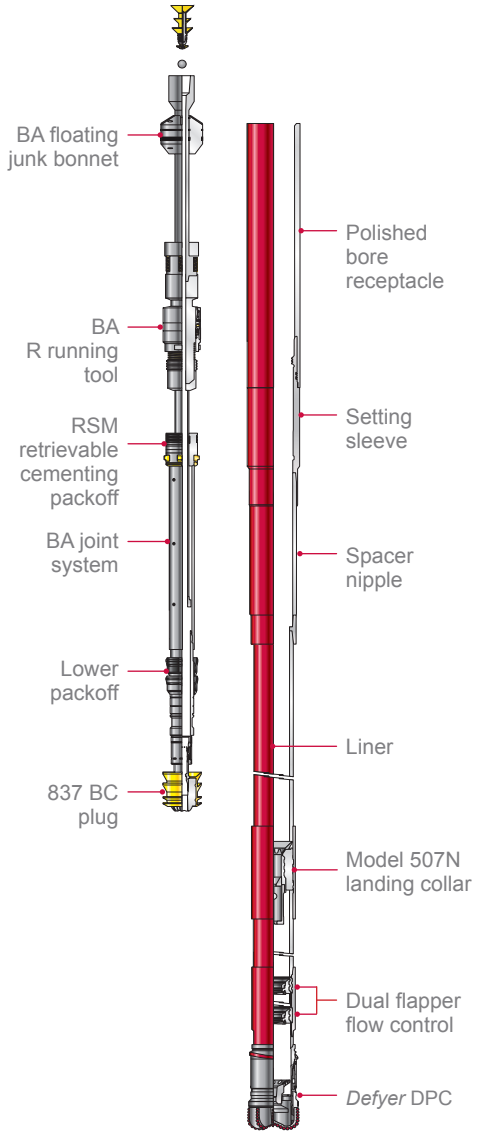
Smoother cementing operations

- Cementing begins almost immediately upon reaching TD. *DwL* technology keeps the casing on or near the bottom.
- The *DwL* system enhances cementing integrity and quality with circulation uninterrupted by tripping until cementing begins.
- The high-quality, near-gauge borehole optimizes hole cleaning, cement placement and bonding, as well as helps to avoid channeling.
- *DwL* technology combined with our patented hydraulic multistage cementing methodology isolates and protects the producing formation from cement.

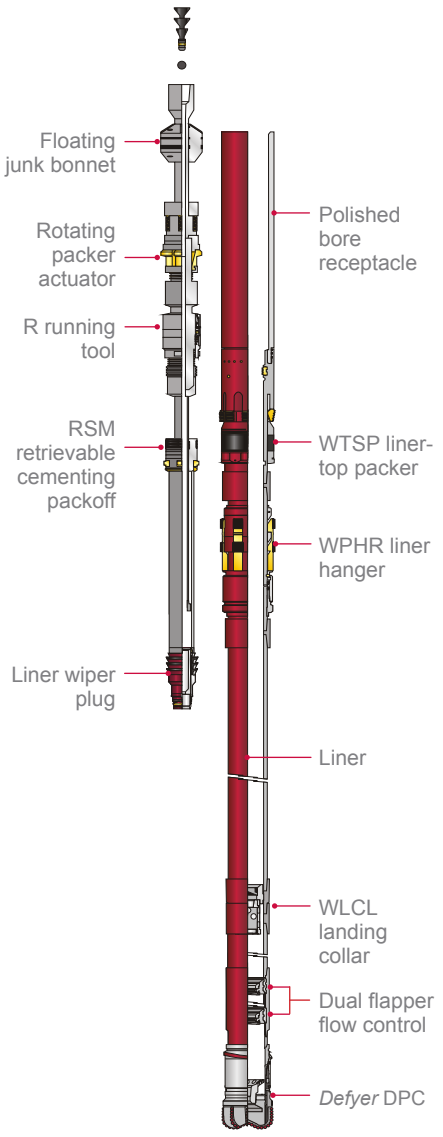
Customized for your environment

Weatherford can customize a DwL™ system to meet your drilling requirements—whether you encounter unstable formations or pressure-transition zones. Our premium production liner systems include polished bore receptacles (PBR), liner-top packers, hydraulic-set liner hangers, and drilling liners that control shallow water flows or tars. From the top of the liner to our unique Defyer™ series drill bits, our engineers specify every element in the string, based on your needs. As your single-source provider, we ensure component compatibility and increased efficiency to reduce costs.

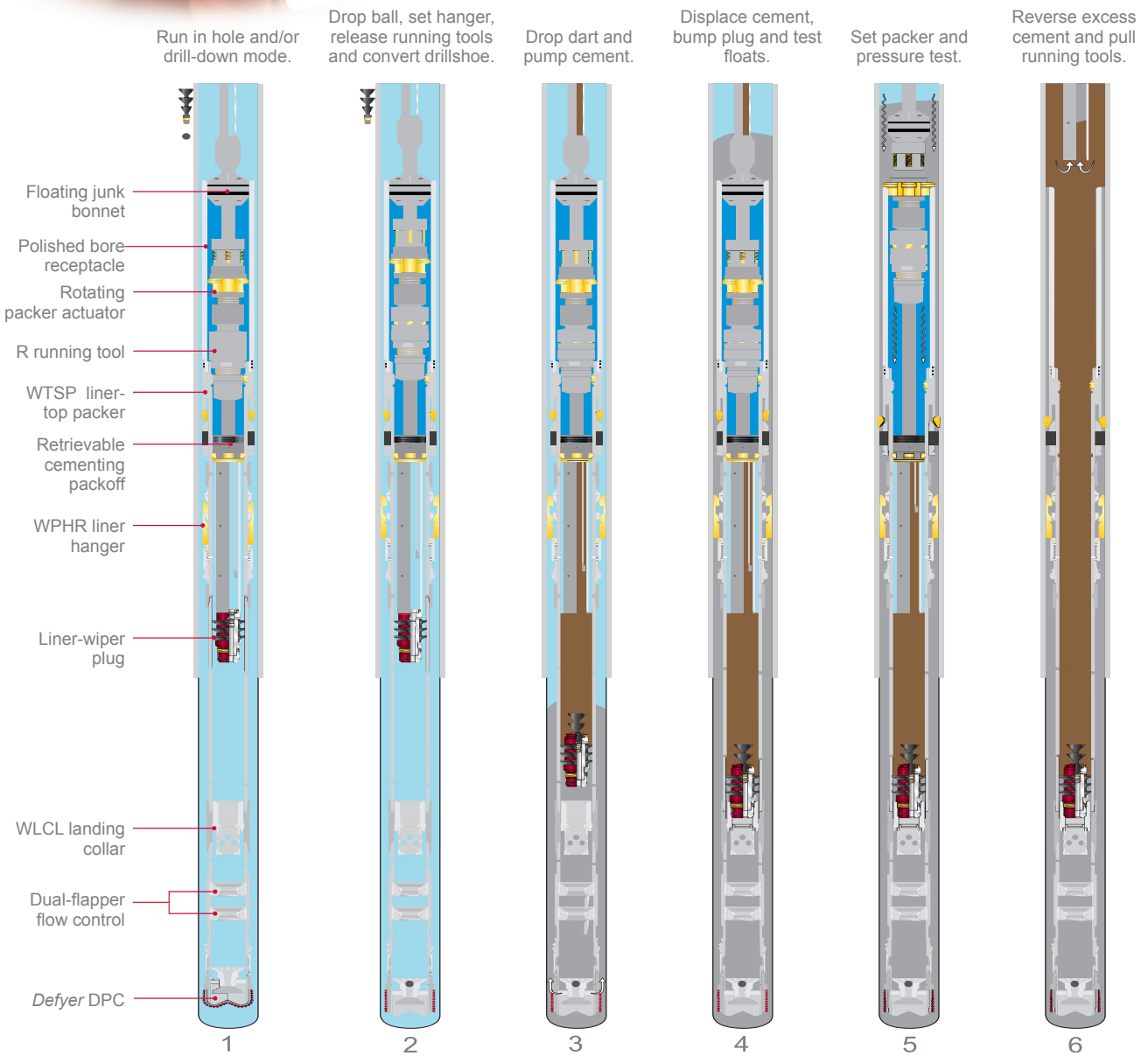
Drilling Liner System



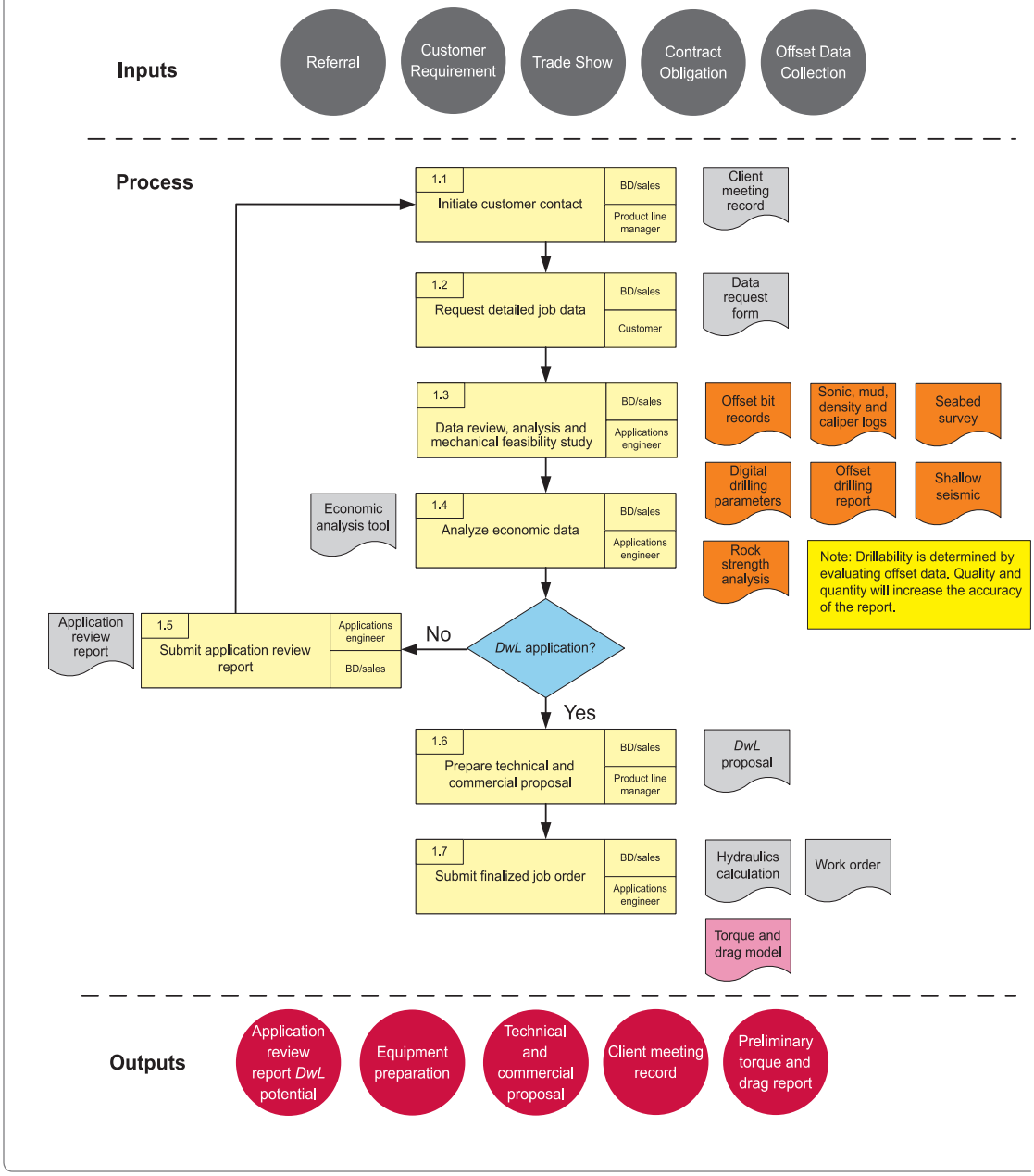
Premium Drilling Liner System



***DwL* setting sequence.** The installation sequence shows a premium *DwL* system complete with liner-top packer, liner hanger, liner-wiper plug and drill bit. The operation is set up to activate the system from a single setting ball, cement the liner, set the packer and retrieve the running tools. The time and complexity of the setting sequence is consistent with that of a conventional liner system.



Drillability analysis. Every Weatherford DwL™ program begins with a top-to-bottom plan that factors in drillable casing bit design, liner-thread selection, torque and drag, pressure and flow regimes, fluid dynamics, liner hanger and running tool selection, liner hanger setting pressures, contingency plans, and more. Weatherford's engineers follow a formal process for planning and executing every *DwL* project. The information you supply to us and your involvement are two of the most important elements in a successful outcome.



DwL system drills through lost-circulation zone, eliminating sticking risk

Offshore Mexico. An operator ran a conventional BHA and experienced lost circulation and differential sticking that had led to expensive fishing and sidetracking operations.

Weatherford's *DwL* system came to the rescue. The system included a Nodeco® liner hanger and a 7- × 8 1/2-in. Defyer™ DPC casing shoe. On reaching TD, the casing shoe was displaced, and the liner hanger was set. The cement job took place with minimal losses, and the WTSP5 liner-top packer was successfully set and tested.

The *DwL* system eliminated the risk of running with a conventional BHA and sticking, and it also avoided the need for a sacrificial 7-in. drilling liner.

Weatherford's *DwL* system saves four days in isolating sandy thief zone

Eugene Island, Gulf of Mexico. Weatherford successfully isolated 120 ft (37 m) of sand behind liner and avoided severe fluid losses by drilling in the liner.

While the length of the new hole opened was relatively short—269 ft (82 m)—it was drilled by rotating 3,438 ft (1,048 m) of 9 5/8-in. liner. There were no mud losses while drilling and cementing through the thief zone—an unexpected bonus after the operator's previous experience proved the section to be extremely sensitive to mud weight.

This successful project followed two previously unsuccessful attempts to drill the interval conventionally, resulting in severe fluid losses and two plugbacks.

DwL system saves US$1 million in rig time, successfully sidetracking well

Offshore Indonesia. An operator had already experienced severe losses to the formation when drilling a previous sidetrack. Now it was up to Weatherford to help drill the sidetrack to a valuable pay zone, using a method that would save rig time and mud costs while enabling well control to be regained.

Weatherford designed a *DwL* system that incorporated a full suite of Weatherford's *Nodeco* liner-hanger running tools, including the patented floating junk-bonnet system, Model R running tool, MX® mechanically expanded ball seat, and a *Defyer* DPC drill bit/casing shoe. Completing the *DwL* system was the WPHR hydraulic-set liner hanger and the WTSP5R liner-top packer.

The liner was drilled down through 349 ft (106 m) of troublesome formations, including sloughing shales, limestone and coal. At a TD of 10,317 ft (3,145 m), the *Defyer* DPC nose was extended, and the liner hanger was set. The cement job was performed, and the liner wiper plug was bumped. The liner-top packer was then set and tested. Because the *Defyer* DPC nose was extended, drillout proceeded smoothly, and drilling continued to the target formation.

The *DwL* system saved a minimum of three days of rig time for a total cost reduction of more than US$1 million. The client credited the *DwL* technology approach with saving the project.

Drill the Undrillable

To learn how our phased approach to drilling hazard mitigation—*explore, engineer, execute*—can help optimize your drilling operations, contact an authorized Weatherford representative or visit **weatherford.com.**

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