Growing multilateral experience brings advances

MULTILATERAL COMPLETIONS continue to grow in number and sophistication because they offer key benefits to operators. In a nutshell, a multilateral well provides one way to meet an operator's ever-present desire for "more production sooner." It can accelerate production, increasing—sometimes dramatically—the net present value of a project.

With the current sophisticated technology and advanced understanding, it seems impossible that multilateral patents were filed more than 70 years ago. But it is just within the past 2 decades that multilateral drilling and completions have become widely commercial.

Sperry-Sun Drilling Services, which has now completed over 300 multilateral well installations at TAML level 2 or higher, says three-fourths of all wells could be multilaterals. Sperry-Sun has learned much from its experience and developed a range of hardware and procedures. It cites these other key benefits of the technology:

- A reduction in the number of wells needed and offshore platform slots used;
- Elimination of a substantial portion of uphole drilling and equipment costs;
- Ability to connect multiple targets in marginal wells, making a field development viable;
- Access to additional reserves in economical fields to extend a well's producing life.

In short, multilateral wells that optimize reservoir management provide operators with the opportunity to improve productivity and reservoir drainage.

A wide range of completion options means the multilateral design can be tailored to a specific reservoir. The technology allows selective through-tubing re-entry, commingled production and isolation, says Sperry-Sun.

But accurately assessing the risks of a given project and designing the proper completion are critical. And once the plan is in place, "a successful multilateral well depends on patiently following operational steps."

Multilateral completions are not simple. Of Sperry-Sun's first 250 multilateral completions, half were at depths from 3,000-7,000 ft, with some installed below 14,000 ft. Three-fourths of the multilateral junctions were set in holes with angles greater than 60 degrees.

Though the benefits of a multilateral completion are great, the project can require 25-50% more time for engineering and planning.

Multilateral completions involve a variety of specialized products and services making a detailed plan necessary. And once the plan is in place, the temptation to take shortcuts in the process must be resisted.

KEY DECISIONS

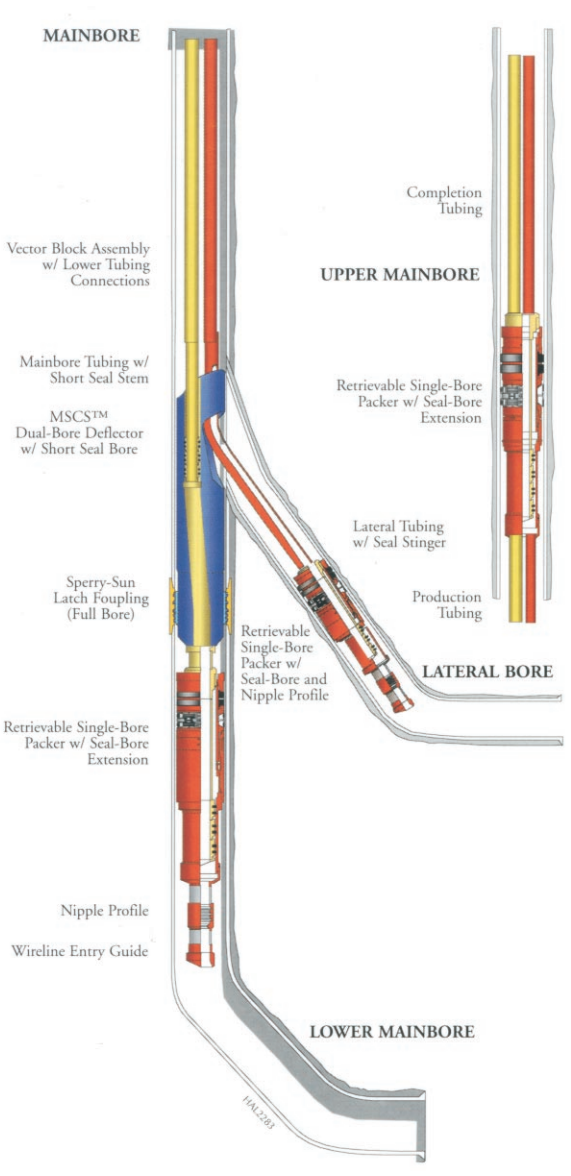
To facilitate planning, Sperry-Sun has developed a multilateral junction decision chart, and a completion systems decision chart. They are organized by TAML level and by well or junction characteristics. TAML, Technology Advancement for Multilaterals, is the classification system established to describe multilateral junction complexity and well types.

The junction decision chart, for instance, considers whether the well is new or a re-entry and whether it is a "debris-free system." It also considers casing main bore access, casing lateral access, whether to drill out top down or bottom up and whether there is sand control at the junction.

For each TAML level and junction description, a multilateral system is suggested.

The completion system decision chart works in the same way, considering the type of completion system, system compatibility and junction hydraulic isolation. It also asks if there is through tubing main bore re-entry, through-tubing lateral re-entry, and the ability to "stack" wells.

Because new wells have fewer restrictions, they are ideal multilateral candidates. The use of pre-milled technology to connect the lateral to the main well bore provides a good junction and eliminates the debris from milling operations.



Multi-String Completion System is for multilateral wells that require complete junction pressure isolation; it allows re-entry.

It also minimizes dogleg problems and ensures repeatable access to the lateral.

There also is great potential in re-entering existing wells and installing a multilateral completion to reach targets missed when the well was drilled.

Key technical factors to consider in planning a multilateral well, according to Sperry-Sun, include:

• Casing and cementation: Casing size, lateral hole size, lateral liner size, cementing placement for the main bore and lateral bore, sand control with slotted screens or perforated pipe;

• Junction integrity: Mechanical tieback of lateral liners, sand production control, formation stability, junction longevity, hydraulic integrity;

• Completion and production: Commingled or segregated production, flow control and isolation requirements;

• Accessibility: Accessibility of the main bore and lateral bore, through-tubing access, non-rig intervention.

SOME DESIGN OPTIONS

Depleted reservoirs can benefit from the use of a stacked multilateral architecture, according to Sperry-Sun.

In this application, it is important that there be no restriction on the main bore so a pump can be placed below the lowest junction.

The dual opposing up dip and down dip lateral configuration uses a single junction and accesses an extended vertical section of the reservoir with multiple lateral bores.

A junction can be used in exploration before a target is selected, then the lateral directional profile can be tailored to place a horizontal at the ideal depth.

In heavy oil projects, use of a "splayed" configuration with multiple junctions along a horizontal has yielded up to 2,800 m of wellbore exposure from a single parent wellbore, according to Sperry-Sun.

Laterals can also be stacked to produce multiple reservoirs and production from different targets may be commingled or segregated.

Some recent projects completed by Sperry-Sun reflect the capabilities of today's technology and equipment.

VENEZUELA

In a heavy oil application, a TAML level 4 tri-lateral was completed onshore eastern Venezuela.

Multilateral completion systems have increased production from the heavy oil reservoir by placing 2 or more horizontal wellbores into the A, B, and C formations from one surface location.

At the time of this completion, 24 junctions had been completed on 13 wells—9 tri-lateral and 4 dual lateral—using Sperry-Sun's RMLS (retrievable multilateral system).

Two pre-milled RMLS windows were installed in the primary 9⅝-in. casing string, allowing two 8 ½-in. laterals to be drilled in addition to the main bore.

Junction stability was achieved with the casing and cementing of both the main bore and the laterals, minimizing sand influx at the junction and the risk of a lateral loss.

NORTH SEA

The first ITBS™ (isolated tie back system) was recently installed for Norsk Hydro's Y-22 well in the Troll Olje field in the Norwegian sector of the North Sea.

The system was designed to create a TAML level 5 for multilateral wells that require hydraulic pressure and mechanical integrity at the junction.

Halliburton Energy Services developed the ITBS system with Norsk Hydro to maximize production per wellhead location. Norsk Hydro's objective in this installation was to quickly and efficiently produce oil from the thin oil rim before the reservoir "blew down."

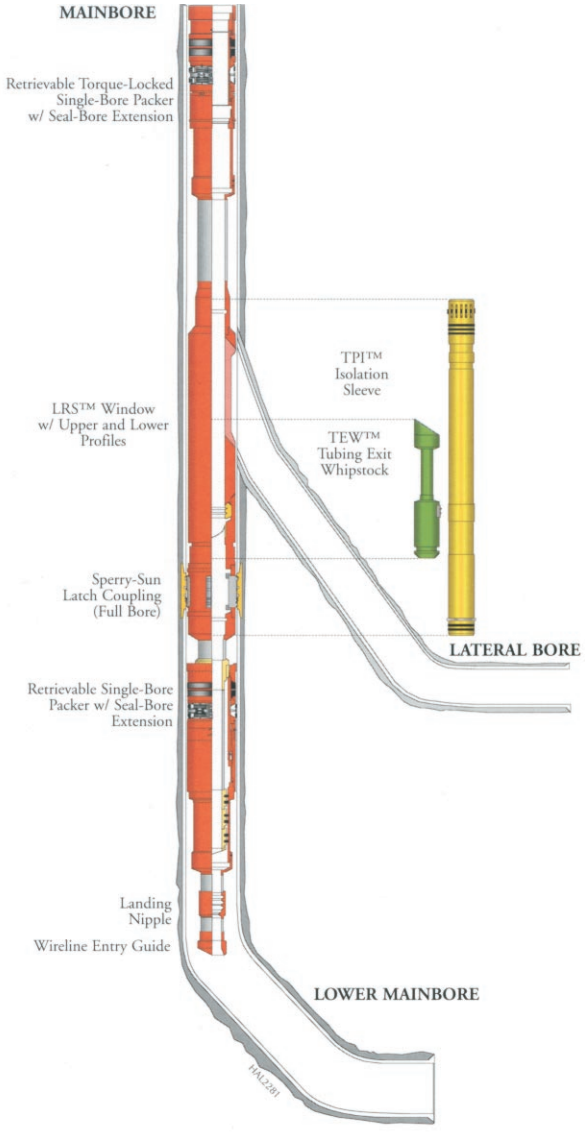
Once this occurs, the gas above the rim can then be produced.

"The installation of this first ITBS system is the latest in a series of successful multilateral installations accomplished by Halliburton in oil fields around the world," said **Jody Powers**, President, Halliburton Energy Services.

"The ability to isolate the junction while controlling and maximizing flow from both the main bore and lateral wellbores offers a cost-effective solution for our clients' reservoir development needs."

The ITBS incorporates a flexible hanger with two semicircular sections to maximize the cross-sectional flow area and to assist with the elimination of sand production at the junction.

It also features the pre-milled RMLS window joint and does not require cementing for hydraulic integrity at the junction.



Lateral Re-entry System's miniature window in the production string allows access to lateral without pulling the completion.

The ITBS system is considered to be a minimal-trip system with a low operational risk.

For instance, only 4 additional steps were required to complete the Y-22 well once the drilling whipstock was retrieved from the wellbore.

Other applications for the system include infill development; slot constrained platforms; access to discrete zones or blocks and areas where environmental considerations require a minimum number of wellhead sites.

Norsk Hydro has used multilateral technology to increase reservoir drainage in the Troll Olje field since 1997 when the first successful cased hole multilateral well from a floating rig was completed.

Additional wells have been completed using the same Sperry-Sun 4503™ system.

In these completions, the multilateral system was run horizontally in 9⅝-in. casing with 7-in. main bore screens below.

A releasable no-go tool was used to locate a 9⅝-in. no-go nipple for depth reference.

After milling the window, a formation consolidation treatment was performed by injecting resin into the formation to prevent sand production and the 7-in. lateral screen liner was installed.

OFFSHORE BRAZIL

The first deepwater installation of the RMLS and MSCS (multistring completion system), a multilateral injection well offshore Brazil, required new technology.

The operator planned a 12¼-in. main bore and an 8½-in. lateral and wanted to be able to inject into the two main zones simultaneously from a single tubing string.

The well is located in 800 m of water and was drilled to a measured depth of 2,500 m. A 9⅝-in. RMLS and a 9⅝-in. MSCS were installed, providing a selective TAML level 5 junction with pressure integrity at the junction and full access to both zones.

The completion had to allow for the lateral and main bore to be both fractured and completed with a gravel pack.

New technology introduced for this special operation included the 9⅝-in. premilled high pressure window system rated at 10,000 psi; the "cut-on-depth tool," which allows the lateral liner to be cut at a specific place prior to washover operations from a floater; and the "junction isolation tool."

ONSHORE ITALY

Agip used multilateral technology to cut costs in its Val Di Agri oil field in Italy where time to drill to the top of the highly compressed limestone formation can be several months.

Reducing the number of surface wellhead sites in a national park is also an incentive.

A 7-in. MERLIN™ system was used to mill a window and create a multilateral junction.

Developed with **Smith International**, the MERLIN system can create a TAML level 2, 3, 4, or 5 well if an MSCS is also installed.

The 7-in. LRS completion system allows through tubing re-entry, flow control, and zonal isolation on coiled tubing or wireline.

Sperry-Sun latch couplings were installed to allow full-gauge access to the lower main bore until the lateral was drilled.

Agip installed two or three latch couplings per well with the intention of using two and reserving the third for future opportunities.

Credit for previous article omitted

The source of information for the article, "Monobore design can benefit high-rate gas wells," Drilling Contractor, *March/April, p 48, was inadvertently omitted. All information for that article was supplied by Halliburton Energy Services and the technology and techniques discussed are those of Halliburton.*

Editor