Solid expandable tubulars optimizing production

SOLID EXPANDABLE TUBULAR (SET) technology has been available to the oil and gas industry for about five years and in that time operators have embraced the technology that it is now a first option rather than a contingency technology. **Enventure Global Technology's** plans for SET going forward is to use the technology to enhance and optimize production from new and existing wells. The company has had its plan in place since its inception and is following a "stair step" progression to where the technology should progress and what the industry is going to need in the future.

The schedule for the technology, parts of which are spread over several years, includes utilizing thicker walled pipe to increase burst and collapse rating, special pipe for corrosive gas environments, and side tracking wells utilizing SET technology.

THICKER PIPE

One thing Enventure is investigating is using thicker walled pipe. Moving into thicker walled pipe is part of the company's plans to begin to evolve SET into a production mechanism by using expandable tubulars as production tubulars. This would also require gas tight connections, which the company has already produced with expandable corrosion resistant alloys.

Presently the company expands 375 wall pipe. Increasing the pipe thickness by between 25% and 50% could increase the collapse rating by 30-50% and possibly higher, according to **Kevin Waddell**, Vice President of Technology and Director of Monobore for **Enventure Global Technology**. The thicker pipe should also result in higher efficiency where connections are concerned.

"We have proven in the laboratory what we can do with thicker wall pipe," Mr Waddell said. "The challenge this year is to bring that into the field."

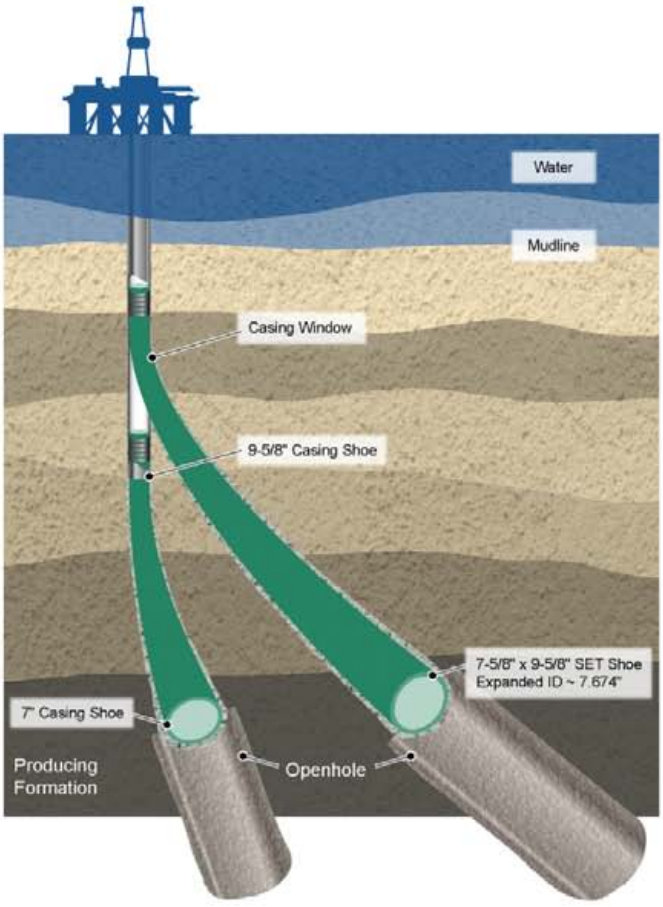
The thicker pipe will still be made to the company's specifications that have been developed with several pipe manufactures.

Enventure has examined two approaches to expanding thicker wall pipe. In terms of reducing friction, the company believes it can optimize the expansion process while keeping expansion pressures relatively low. Also, there are alternative methods to expand pipe, Mr Waddell said, by keeping a relatively low working pressure but generating very large forces for the expansion.

SET is expanded by approximately 16% by utilizing the surface area of the expansion cone that creates a seal to generate the force required for the expansion. With thicker walled pipe, the force regime increases significantly, according to Mr Waddell.

"There is a point that you will actually get into the yield area of the pipe if you depended solely on pressure," he said. "What we will see in the future is a balance between hydraulics and mechanically-generated force (during expansion)."

Various alternatives of force generation are being tested presently, including the expansion systems on monodiameter wells. "There are only so many ways to generate force," Mr Waddell explained. "The trick is to combine them into systems to achieve force generation while trying to keep things as simple as possible."



Solid expandable tubular technology in conjunction with sidetracking technology can result in larger recompletions to optimize production.

OFF-THE-SHELF PIPE?

With regards to using off-the-shelf pipe, Mr Waddell said the company has "been there and done that, and basically we ended up with the model we are currently working with.

"I don't think there has been enough thought put into that and the ramifications at this point," he continued.

Mr Waddell's argument is that SET technology is only about five years old and the industry is still very sensitive to failures. "If you can't go out and consistently perform and have a high degree of reliability, then the technology is going to suffer," he explained. "Our belief is that off-the-shelf expansion pipe right now introduces risks into that equation, and that is the last thing that I believe operators want to see."

EXPANDABLE SIDETRACKS

Mr Waddell is excited about applying SET technology for sidetracking wells from existing casing. The company has performed about 15 SET sidetracks that retain the hole size, enabling operators to optimize the reservoir or in some cases allowed them to run the next casing size or an intelligent completion. The SET sidetracks so far have performed very reliably and with high added value, according to Mr Waddell.

"There are a lot of interesting possibilities for a combination of expandables, multilaterals and intelligent completions," he said.

In one case, a company performed a deepwater sidetrack where the operator

encountered problems at a certain well depth. The operator needed a certain hole size for testing. Enventure was able to perform the sidetrack and complete the well at rates the operator required.

Expanding a sidetrack is essentially the same as the typical expansion operation. The company did, however, work diligently with several window suppliers to quantify a system that could be customized to meet requirements for both the window, whipstock and the expandable system.

"The windows are generally a little longer and they are polished," he said, "but all of the companies that have window systems can meet our criteria."

WATER CONTROL

Another application for SET is water control, which the company performed in a well in the Far East. The operation can control unwanted water, or it could be used in a reinjection scheme. The company used expandables with "swellable" elastomers that react with the formation water. When the operator understands the fracture orientation and where the fractures are located, it maps which fractures are water contributors. The swelling elastomers are on the leading edge and at the top on the outside of the expandable pipe, essentially forming a seal between the particular water-producing fractures.

When the pipe is expanded the water reacts with the swelling elastomer, the water energizes the seal and it begins to swell, contacting the wellbore and creating a seal over the particular water interval.

AGAINST THE FORMATION

Expanding against the formation or even into the formation is another new application for SET. About half a dozen of these operations have been performed. The pipe was expanded against the formation because of a pilot hole and a bicenter bit, or underreamer configuration where the expandable OD is at or slightly exceeds the gauge of the hole. One of the tests, according to Mr Waddell, was conducted on a monodiameter section of a well.

"The expandable is actually extending into the formation slightly and as a result there is a very small micro annulus," Mr Waddell explained. "We have seen instances where we have been able to affect a shoe seal."

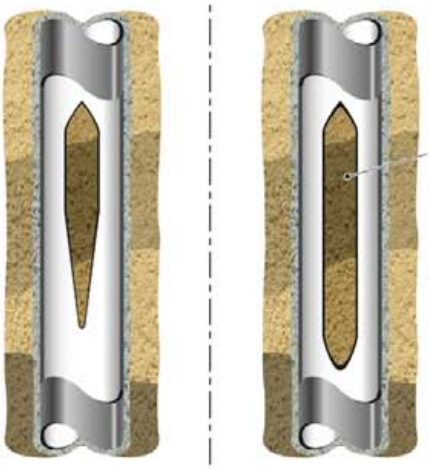
Conventionally, a liner would be run and cemented, relying on the cement to provide a hydraulic seal. In one case the company added elastomers to the outside of the casing similar to an open hole application. They were energized against the shales since they were competent enough to support the elastomers, which generated a seal at the shoe.

"The implication of this is being able to potentially eliminate a cement job in those instances where you are running a drilling liner and all you are interested in having is having a seal at the liner top.

"This could result in potential added operational efficiency because you could eliminate the cement job and reduce costs."

"There is a lot of ground work that has to be done with the Minerals Management Service," Mr Waddell noted, "but with the results that we are seeing (in tests) and subsequent testing with actual formations, this is something that is going to definitely be explored (by Enventure) in the next year."

13 CHROME



Conventional Window | Enhanced Window

Advancements have resulted in milling systems that produce a full gauge window for nearly the entire window length.

Natural gas is beginning to be positioned as more of a global energy source. Consequently, the company is beginning to see the potential to go back into existing gas wells that may be tubing constrained to reline an existing wellbore that would then become a production conduit.

"What we see is a well with a conventional string and then run 13 Chrome inside of it," Mr Waddell said.

"The problem is you have to work inside that ID so your tubing has constrained the potential of the reservoir. Additionally, you may be working with higher pressures."

In the situations where an operator wants to get the gas to market quicker and optimize the reservoir while producing at a good working pressure, Enventure has pulled the corrosion-resistant constricting tubing out of the hole because the ID was not large enough. The company then relines the existing casing with expandable tubulars with 13 Chrome layered on the ID, exposing the 13 Chrome to the production string.

"That opens up the wellbore and lets the reservoir breathe so you can produce at a higher rate but with a lower pressure," he explained.

The company has performed several of these applications onshore in Europe and offshore in Southeast Asia.

MONOBORE WELLS

Enventure was expected to have completed a well jointly with **Shell** to test the design and tool functionality of monobore wells. The test included refining operational procedures, assembly and disassembly procedures, equipment handling and to demonstrate repeatability of the operations. The well, begun in November 2004, was expected to be completed by the end of January 2005.

A monodiameter well, according to Enventure's definition, is two consecutive liners run without a loss of inside diameter. Also, a monodiameter or monobore well is not necessarily the same casing size from the top of the hole to the bottom, according to Mr Waddell, although that could be an option in the future.

Under the present definition, there would be a surface and an intermediate casing string and below that the operator might run a monodiameter section that could include two, three or four consecutive strings to reach the objective.

"This monobore test is essentially a dress rehearsal for the company to gauge the tool design in an actual downhole environment," Mr Waddell said.

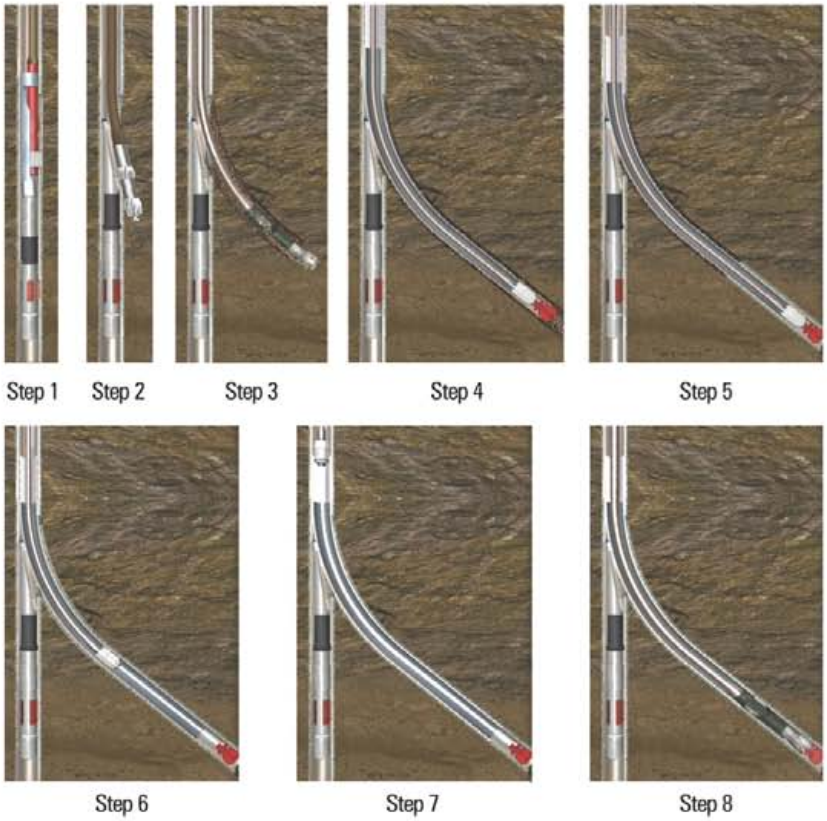
"This is a different requirement than how we conventionally expand pipe," he continued. "The expansion process as it exists results in about a 16% expansion. With monobore diameter we are looking at 18%-23% expansion. Because of the higher expansion ratios the force regime is higher and we have to be able to generate that force in different ways so the tool string is different that what we use typically."

A "true" monobore well, with one size tubular from top to bottom, is well into the future.

"This type of application realistically would be 2010," Mr Waddell said. "What we are doing now is testing the repeatability of the technology. Ultimately what could be done from the very top is to have 11 ¾-in. tubulars, even conductor pipe, and the wellbore from that point would all be monodiameter."

This technology could potentially result in quite a large cost saving. For example, only one bit configuration would be necessary to drill only one hole size. Drill pipe would not have to be changed in most instances.

Utilizing only one casing size results in consolidation and standardization of equipment and tubulars. Monobore technology also virtually guarantees the operator a specific ID with which to work during production design and optimization.



Testing has resulted in no problems running solid expandable tubulars through specially cut casing windows. A solid expandable tubular deployment sequence is illustrated above.