The Challenges Ahead for SlimWELL™ Technology

A Perspective by

Paul Howlett - Managing Director Caledus Limited

Caledus Limited was formed in February 2003, as a service sector supplier to provide drilling, completions, and well services to the upstream oil and gas industry. The business is headquartered in Aberdeen, Scotland to provide for the North Sea as well as International locations.

Slimming down the oil and gas well geometry to reduce the cost of well construction has been an economic goal of operators for many years. To achieve the desired size of pipe across the zone of interest but slimming down the rest of the well construction geometry to get there, and still enabling the desired size and configuration of the completion to be installed are the main objectives and challenges to those operators. Today, whilst the desire and need exists no universally practical system has been made commercially available to achieve these goals.

There are challenges ahead, numerous technical ones, but perhaps as importantly, convincing well construction engineers and their managers to break with convention and use SlimWELL™ techniques

This SlimWELL™ system will allow the ideas, concepts, prototype designs and tests achievements made so far to become commercially available to operators for the first time. A significant amount of work has already been conducted to confirm this is worthy of commercialisation. One size of the system has been built and tested; several more sizes will be required to construct a complete oil or gas well. SlimWELL™ is well past the conceptual stage; it requires significant investment and dedication to fully commercialise it, so that operators and the oil and gas industry can benefit from it.

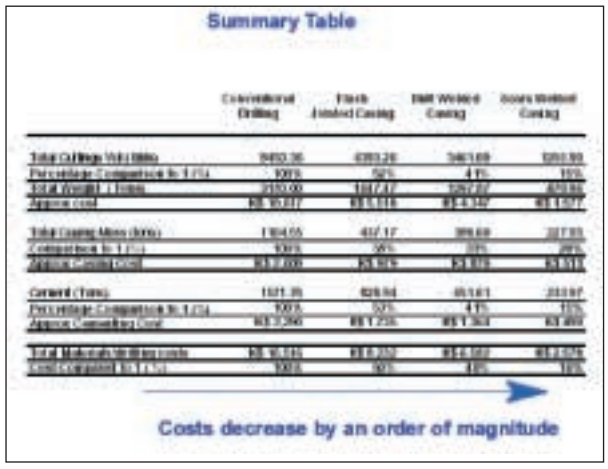
"This system has the potential to stimulate exploration and appraisal activity if it can truly reduce construction costs by so much, very interesting" ***Exploration and Development Manager North Sea"***

The commercialisation of SlimWELL™ must almost certainly come through a service sector 'SME', a group of industry experienced, like-minded, strong willed, entrepreneurial, commercially astute individuals dedicated to making a real difference to the industry. **Caledus Limited** has been formed to be such a company. SlimWELL™ is already a patent granted system, in several countries with further patent protection potential as a direct result of the development.

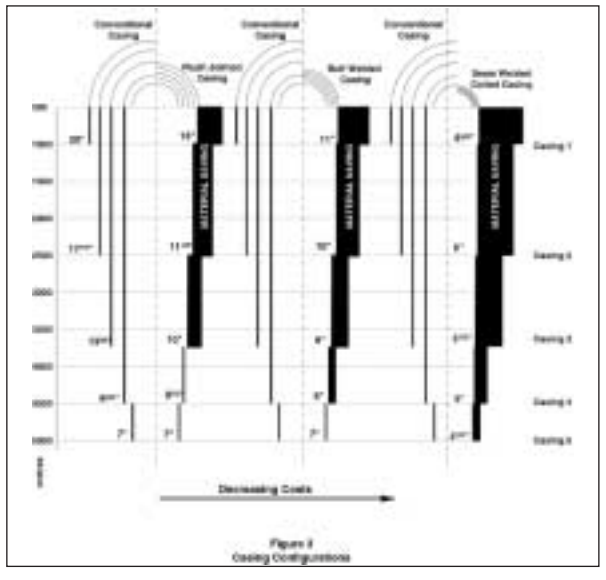
Pictured some of the SlimWELL™ test equipment prior to a test well deployment.

Significantly reduced well construction cost has the potential to stimulate exploration and appraisal in mature basins, to make development projects economically viable when they are not today. Many operators debate the need to reduce well cost by 50% or more, and challenge the service and contractor sectors to address this. SlimWELL™ truly has the potential to achieve these cost reductions. There are challenges ahead, numerous technical ones, but perhaps as importantly, convincing well construction engineers and their managers to break with convention and use SlimWELL™ techniques. The oil and gas industry is generally risk adverse and does not easily break with convention. Caledus has to make this decision easier for them to take, by fully developing and making available a commercial system and proving its technical integrity and reliability in the harsh environment of oil and gas well construction. There is a global market for SlimWELL™ techniques if it can be made available. Caledus is committed to growing a sizeable business to allow this technology to be accessible on a worldwide basis.

The table below helps explain the impact of the SlimWELL™ system on well construction costs.



Below is a simple diagram that suggests the reduction in sizes achievable from the conventional by the use of SlimWELL™ technology moving from left to right.



What lies ahead?

SlimWELL™ is a development for the upstream oil and gas industry that aims to reduce the cost of oil and gas well construction by more than 50%.

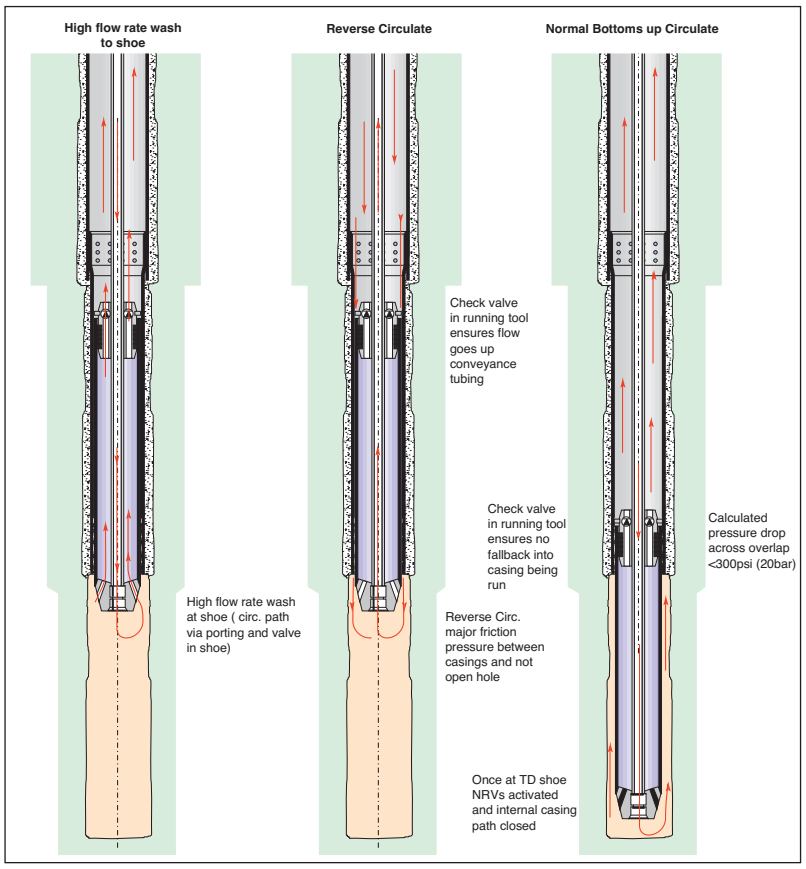
Today, most oil and gas wells are constructed by utilising long established and traditional means. Starting off with large diameter holes (26"-36") that are drilled or jetted open to insert, cement in place, and secure appropriately large diameter pipes or casings (20"-30"). These casing pipes are generally 40ft long each, threaded at both ends, with an up-set outer diameter threaded coupling that allows numerous lengths to be secured together, supported and run down inside the wells. These early casing strings are then drilled through with appropriately large diameter drilling tools, to produce lengthy open holes beneath them that subsequent large diameter casings are installed in. Large volumes of drilling fluids or 'muds' are required to circulate around the system, be pumped down the drilling equipment and help remove, by circulation and collection, the cuttings of geological formation that are produced in the drilling process.

"We are one of the largest independent operators in the North Sea. It is access to technology like this that can help us improve performance and improve our ranking, I'll set up a session with some of my engineers for you" ***Performance Improvement Manager***

"This could achieve many of the objectives of an expandable casing construction without the associated risks of expandables" ***Drilling Manager, for North Sea Platform***

These weighted muds help to keep the drilled holes open while the casings are installed and secured in place with cement slurries. Large volumes of cuttings are produced that have to be disposed of in one way or another. Each casing string is run and cemented in place at an appropriate depth, depending on the formation types and formation strengths or pressures encountered. Each of these casings are usually run from the original top of the well to each of their setting points on every occasion, overlapping and covering up the previous strings. In this manner the same depth may end up being covered over more than 4 or 5 times. It is often the case that the final casing is suspended from the previous one then tied back

The schematic below depicts the circulation options during a SlimWELL™ installation



from an installed liner with another casing string to the top of the well as part of the final completion process.

In this manner eventually the particular depth of the desired zone of interest is encountered and the last string of pipe is placed across this area. If operations have gone to plan, the size of the last casing or pipe is the optimum one as dictated by the well construction engineers at the outset of the drilling program. This optimum size of pipe will cater for the best flow output achievable of the oil and or gas if the well is to be a producing well, or optimised flow in if the well is to be an injection well designed to enhance production of other nearby producing wells.

In short to end up with a reasonable size of pipe at the zone of interest, say 5" or 7" in diameter, the wells start with pipe sizes of 20" and 30", each with a corresponding size of hole being drilled to allow safe passage of that pipe size into the well. Large pipe sizes being installed means large volumes of mud required, and large volumes of cuttings being produced. Generally larger diameter holes will take longer to drill than smaller diameter ones in the same geological formations, and more mud volume will be required during the drilling phase, consequently more mud will be consumed in the process.

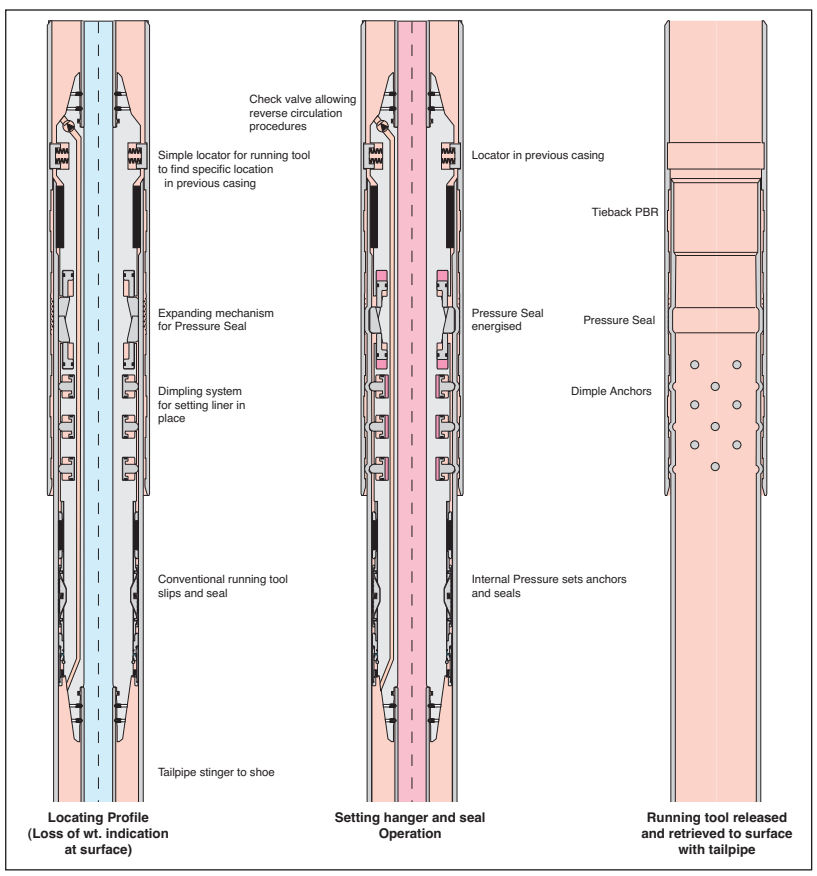
Whilst the above is a very crude description of oil and gas well construction methodology it is easy to understand that if a practical method of producing the same size of pipe at the zone of interest can be produced by using smaller sizes of pipe, drilling smaller holes, producing less cuttings, using less mud, less casing, and performing the operation more quickly, more safely, and with less environmental impact then this should be pursued, especially if the same level of technical integrity can be achieved for the equivalent or lower risk.

SlimWELL™ is a practical system that has the potential to achieve all of the advantages of slimming down well construction methods and associated costs to end up with the desired size of pipe at the zone of interest.

"This SlimWELL™ technology has the potential to stimulate wells drilled on our mature assets, that at £6m a well we don't do, but at £3m per well we would" ***Senior Well Technology Engineer***

SlimWELL™ utilises a system of running tight tolerance, close clearance flush outer diameter pipes with-in each other, securing them with novel liner hanging, sealing and supporting means, and the ability to install them while overcoming the inherent technical difficulties in doing so. One of the most significant being the potential swabbing or surging effects of the close tolerance pipes acting like pistons while moving inside the wells and causing pressure fluctuations within the well that could cause well control difficulties, ultimately leading to a 'blow-out' if the effects go un-checked. SlimWELL™ overcomes the potential swabbing or surging effects and brings stability with novel flow diversion means that help make the system practical.

Below is a schematic that shows in some detail the tooling required to convey, support, anchor, and seal the SlimWELL™ concept.



"We are planning to skip and ship for disposal our water based mud drilling cuttings for a large island project, a huge environmental task. This SlimWELL™ is VERY interesting as it would drastically reduce the magnitude of that task" ***Drilling Manager***

The system has been prototype designed, built, and tested in one size, in the middle of the full range of sizes, to prove the concept works. This tooling was bench tested and a small-scale test well functioned to prove further that it is viable. Numerous in-depth technical presentations have been conducted to potential end users, with favorable and encouraging feedback.

It is our goal to produce a practical set of solutions to SlimWELL™ well construction methods that significantly reduce well costs, stimulate exploration and appraisal activity, inrease project developments, reduce operational risks, improve safety, and reduce the impact on the environment, whilst at the same time growing a profitable business, headquartered in the North East of Scotland, further enhancing the reputation that SME's are the pool of talent in the UK that bring innovation to the oil and gas service sector.

SlimWELL™ Technology Facts

- SlimWELL™ technology is a new and innovative method to drill and construct wells to reduce operating costs, initially up to 50% and ultimately up to 80%, when compared to conventional practices. SlimWELL™ will rival expandable tubular technology completions.
- SlimWELL™ achieves the desired size of tubular at the reservoir by utilization of an innovative running tool and liner hanging system. The system enables a sequence of reduced clearance casing strings to be run, avoiding all the associated problems, such as high swab and surge.
- The benefits of reducing the casing sizes from top to bottom while maintaining the optimum size across the zone/s of interest are significant:
- **Economic,** fewer consumables such as casing, cuttings, drilling fluids and cement, faster drilling, lower logistics and reduced rig costs.
- **Environmental**, fewer cuttings and less drilling fluid to dispose of.
- **Reduced Risk**, fewer big casing operations, reduced risk during transportation and handling. Wells may be developed more quickly and more safely.
- **Contingency**, additional casing strings may be run without affecting the final hole size. Additional liners may be spaced over troublesome zones. In the longer term a reeled casing system will improve integrity by eliminating connections.
- **Bottom-Up design**, allows the well to be designed for the required production/tubular without excessively large top-hole sizes.
- **Abandonment**, simplifies the well abandonment process due to the lack of overlapping casing strings and potential leak paths at the top of the well.

Innovative flow diversion methods and liner hanger system overcome the operational restrictions of running tight tolerance clearances between the ID of the previous casing and the OD of the new casing. This innovation offers two circulation methods while running, once at TD conventional 'bottoms-up' and cementing methods may be utilized.

SlimWELL™ construction techniques offer substantially greater pressure containment in surface pipes when compared to conventionally drilled wells, making it advantageous for HP/HT wells.

SlimWELL™ techniques also lend themselves to metal-to-metal seal liner hanger forming a slim-junction in a multilateral well.

SlimWELL™ techniques can increase the number of wells, which can be drilled per slot on an offshore platform, by starting with smaller upper casing strings.