



An Intense Stance in Sand Control

As Weatherford marks its 500th expandable sand screen installation, the growing demands and diversity of well completions continue to drive innovation, prompting integration of conventional and expandable well screen technologies to bring all experience and resources to bear on solving sand-control challenges.

When the 500th ESS[®] expandable sand screen installation was performed late 2007, it was appropriately part of a 7-inch ERC[™] expandable reservoir completion system. The recently introduced 7-inch system is on the leading edge of the expandable completion technology that Weatherford's ESS systems ushered in more than a decade ago.

The multizone completion for Chevron, installed in The Netherlands, is one of a growing number of ERC systems in place around the world. Developed in collaboration with a major international operator to address critical reservoir development needs, the unique 7-inch ERC system is finding quick acceptance in the field—particularly in high-cost, deepwater environments. It is also a much-needed enabler for the intelligent completions required to economically produce the difficult reservoirs there.

The 500th ESS system, featuring newly developed 120-micron screens to control production of finer sands, might be described as the pointy end of Weatherford's expandable sand-control services. Leading to that point is an extensive history of innovation and practical experience, with expandable sand screens available in sizes ranging from 2-7/8 to 5-1/2 inches and now 7 inches. (See sidebar on Page 18.)

"Five hundred installations is an important milestone because of the experience and industry acceptance it signifies," says Gary Smart, Vice President of Weatherford's Well Screen Technologies group. "Our clients have confidence in the technology and what it's capable of achieving. As a result, expandable sand screens are now a regular option in their sand-control toolbox. We're also being planned into multiwell field programs and called on to support increasingly aggressive, diverse applications and unconventional reservoirs."

The success of ESS technology is based on performance achieved by compliantly expanding the screen against the wellbore, removing the need to place gravel for filtration of formation sand. Since the mid 1990s, the screens have been proven a highly effective improvement to gravel-packing methodologies, reducing well costs and significantly improving productivity.

Proving the 7-inch ERC System

"As reservoir complexity increases, so do requirements to manage and isolate production from many reservoir horizons," says Martin Geddes, Global Product Line Manager for Well Screen Technologies. "This 7-inch ERC system sets the stage for the next generation of multizone delivery."

Because it segregates zones in an open hole, using a modular assembly of components, the Weatherford technology eliminates the need to case, cement and perforate the hydrocarbon-bearing reservoir section. This capability dramatically reduces costs while retaining the multizone control associated with a cased hole.

Comparatively large at 7 inches, the diameter of the system is important because it supports the high production potential of an open-hole completion and provides room for the intelligent hardware required to manage multiple production or injection zones over the life of the well. And a larger diameter means a greater screen surface area, which increases flow and reduces plugging potential.

The modular ERC system also extends the range of applications and integrates nicely with other isolation media, such as swellable packers and standard 7-inch casing, to span problem sections in the reservoir.

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Challenge-Driven Technology

"The expandable multizone technology was developed with a major international operator who needed to control sand in multilayered formations while maintaining pressure isolation between zones," explains Geddes. "It reflects the challenges they identified in developing their reservoirs. With their input, we established clear objectives and began to apply Weatherford's extensive knowledge and expertise in expandables to develop the best solution."

The 7-inch *ERC* system is a unique technology because it combines slotted expandable screens with solid expandable tubulars for the first time. Expanded in open hole, both components compliantly press against the borehole, with the *EZI*™ solid expandable zonal isolation tubulars—sealing up to 3,000 pounds (20.7 megapascals)

of differential pressure—bracketing each length of expanded sand screen. The combination of expandables is key to the system's success.

"The main challenge in developing the 7-inch system was integrating solid expandable technology for zonal isolation with slotted expandable screen technology," says Geddes

"Our *EZI* products are enlarged through rotary expansion; but our slotted tubulars used for screens are expanded axially, from the top down, using a specialized tool. A significant part of the development effort focused on the screens withstanding the torsional load generated during expansion of the solid tubulars." The solution involved a change to premium standard connections to handle the high torque, which allowed use of rotary expansion for both screens and solids.



the human element annabel green

Annabel Green was in Rio, with bags packed for a late-March trip to the UK. The coming journey will bring her full circle from where she started with Weatherford—back in Aberdeen. And it will put one of Weatherford's most experienced expandable completion experts in a senior supervisory position in the newly integrated Well Screen Technologies group.

Currently in Brazil as the technical manager supporting business development in Latin American and North Africa, she will broaden her role considerably with new responsibilities for all expandable and conventional well screens, for engineering functions in manufacturing and research and development, and for product development management and global application teams.

Green's pedigree with expandables goes back to the beginnings of the technology. She was involved with flow control at Petroline when Weatherford acquired that company in 1999. (Petroline and Shell had been working with slotted tubular technology—a key to expandable screens—since the early 1990s.)

After the Weatherford acquisition, Green joined the expandables group. She has been there ever since, most recently leading the development of the 7-inch *ERC* (expandable reservoir completion) system.

"One of the reasons I've been here so long is that we are always changing—there are always new challenges," says

Green, a mechanical engineer with a degree from the University of Leeds in the UK.

That change includes innovation in the hardware as well as methodologies and thought processes. "While we have many clients who have used the technology for years and are comfortable with how it's applied and its benefits, we are still introducing new clients through education and experience."

The need to educate is diminishing as years go by and the industry regularly incorporates the technology in its everyday applications. "Generally speaking," she says, "they get it. High-inflow, low-skin, large-ID, compliant sand control are what clients are designing and asking for."

"It has changed a lot," she muses about expandables development. "In the early days, we were only expanding screens; now we've moved the technology to where we're providing a full range of service capabilities and expertise."

Today the primary emphasis is on developing the hardware. "With the benefits of the system well established," Green observes, "The work we're doing now is mostly focused on improving functionality and expanding the range of applications."

Still, for all the technical innovation and changing of perspectives, the bottom line has remained clearly in sight. "In the end, it's the production benefits that drive this technology forward," she says.

Company	Total Installations	First Installation	Diameter Sizes	Mesh Sizes	Expandable Material
Weatherford	550+	Feb 1997 Oman	4-, 4 1/2-, 5 1/2-, 7-in. <i>ESS</i> systems, depending on hole size and application; 7-in. <i>EZ</i> systems for 8 1/2-in. open hole	120-, 150-, 230- and 270-micron Dutch twill weave	Standard metallurgy is 316L stainless steel; other metallurgies available to suit service conditions
Company B	28	March 2002 GoM	6 1/8- and 8 1/2-in. systems	125-, 175-, 250- and 300-micron	Base pipe; PF-50 (proprietary alloy) and 316L stainless steel screen: 316L stainless steel and alloy 20
Company C	50+	Nov 2001 Indonesia	4 3/4-, 6 7/8- and 7 5/8-in. systems	fine, medium and coarse	316L stainless steel

Note: Figures for Company B and Company C were derived from an article in the August 2007 issue of *Offshore Engineer* magazine.

Deepwater Isolation

"The 7-inch *ERC* system has been quickly accepted by the industry," says Ken Miller, Commercial and Business Development Director for Well Screen Technologies. "National oil companies, majors and independents are applying the technology around the world, including West Africa, Europe, the Middle East, North Africa and Asia-Pacific."

Many of these wells are deepwater applications, where multizone completions allow operators to produce assets with a single, longer wellbore rather than multiple wells.

"The ability to isolate zones is the *ERC* system's greatest differentiator in these applications," explains Miller. "It is a critical building block for the selective management of multiple zones—which is key to the viability of many of these fields."

That was the case for BP. The company has used *ESS* systems extensively in its global operations. And when BP needed a new solution for wells being planned in the Caspian Sea, it joined with Weatherford to develop the *ERC* system.

"The first three *ERC* installations were done for BP," comments Geddes, "and today their engineers plan to install ten or more systems per year in the Caspian Sea alone."