ESS technology improves productivity, cuts cost

EXPANDABLE SAND SCREEN technology can improve well producing rates and reduce well construction costs compared with conventional approaches to sand control.

As a replacement for sand control techniques such as gravel packs or screens, the technology can also be installed through tubing.

Early this year, **Weatherford International Inc** announced that a new world record run for its Expandable Sand Screen™ (ESS) was performed on **Shell UK Exploration and Production's** Brigantine-A offshore gas well at 15,843 ft with 7,200 ft of 6-in. horizontal reservoir section.

In total, 7,000 ft of 4-in. ESS was deployed into the well. Of this 4-in. ESS, 4,920 ft was successfully expanded into the 6-in. horizontal hole section.

Full expansion to contact the 6-in. borehole was achieved using a 4.75-in. solid fixed cone, followed by Weatherford's Compliant Rotary Expansion System (CRES).

The initial cleanup production rates indicate performance improvement of over 20% compared to plan and well cost savings in excess of £2 million.

FEATURES AND BENEFITS

ESS is a replacement for conventional sand control technology, such as gravel packs or screens that can also be installed through tubing.

The ESS is expanded against the bore of the well eliminating the annulus normally found around sand screens.

Weatherford cites these features and benefits of the technology:

• Unique screen design for increased reliability and longevity;

• Slim design to facilitate deployment;

• Large expanded OD contacts the wellbore, stabilizing the formation;

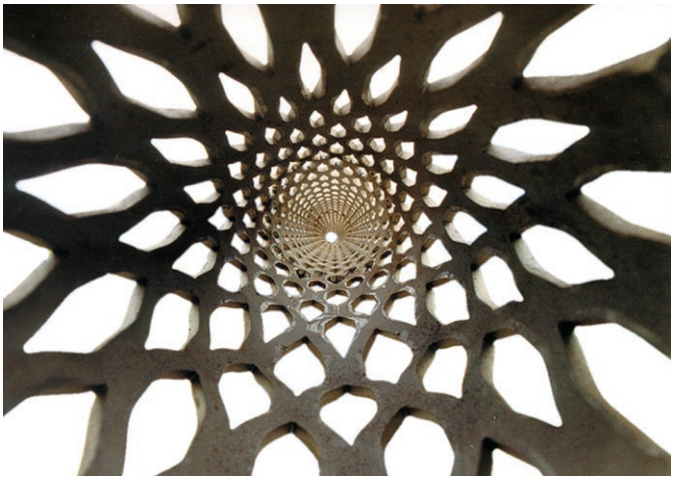
• The system is designed to resist erosion and plugging;

• A large ID maximizes well intervention options;

• Class leading flow area optimizes production;

• It allows successful water and gas shut off operations;

• The technology dramatically reduces installation costs compared to a gravel pack.



The Expandable Sand Screen is expanded against the wellbore, eliminating the annulus that is normally found around conventional sand screens.

The ESS is made of metallic components designed to withstand the toughest well environments.

It combines four basic elements to deliver sand control in various well conditions while maintaining high reliability, longevity and optimum hydrocarbon production.

The ESS expands against the borehole providing support and eliminating the annulus, but it can be installed as quickly and as easily as traditional screens.

Because the annulus is eliminated, reservoir treatment and isolation become possible.

Since the ESS is expandable, it is also suitable for remedial installations, avoiding expensive workover costs.

Its remedial use is especially attractive for multiple zone completions where only one intermediate zone may require sand control.

Placing conventional screens across intermediate failed zones leads to small diameter restrictions which limit well accessibility and production potential.

SYSTEM COMPONENTS

The ESS Components are designed to be easily run together and all provide a sand tight seal. There are no "blank areas" on the components so each part of the system contributes to flow.

The system components include an Expandable Top Connector (ETC); Expandable Sand Screen Joint; Expandable Bottom Connector (EBC); Expansion Cone; and Expansion Mandrel.

The Expandable Top Connector is a short pre-formed section of ESS that connects the ESS assembly with the blank space-out pipe at the top of the system.

Essentially a cross-over device, the ETC also functions as a housing where an expansion cone is positioned prior to make-up and running in hole.

The construction is very similar to an ESS joint, but it has a pre-formed shape and a receptacle for an expansion cone.

The Expandable Sand Screen joint consists of slotted steel tube, around which overlapping layers of Petroweave filter membrane are attached.

A final layer of pre-slotted steel plate is then formed around the outside, keeping the filter membrane firmly sandwiched and protecting the filter media from damage during deployment. The joints have integral slotted connections.

The expandable bottom connector is a short section of ESS which terminates an ESS assembly and provides a positive location for the expansion cone to land and remain.

Positioned at the base of a section of ESS joints, the EBC is threaded to allow the attachment of other completion accessories such as a circulation shoe assembly or a bull plug.

With construction similar to the ESS

Figure 1: ESS field history

Well	Size, length and rating	Depth and hole	Application
Q2 2000 Champion W 13	4 1/2-in., 640 ft & 4-in. 420 ft, 150 micron	10,334 ft 6.184 in. @ 61 deg	Significantly reduced cost compared to gravel pack
Q2 2000 SDTQ-2	3 1/2 in., 1,140 ft 270 micron	7,962 ft 5 in. @ 90 deg	Production increases from larger flowing bore
Q2 2000 Champion W 15	4 in., 300 ft & 4 in. 270 ft Both 150 micron	9,110 ft 6.184 in. @ 0 deg	Significantly reduced cost compared to gravel pack
Q2 2000 W Delta 117	4 1/2 in., 40 ft 150 micron	7,200 ft 7-in. csg @ 20 deg	Internal gravel pack alternative--less cost
Q1 2000 Yarumal 10	5 1/2 in., 40 ft 270 micron	7,291 ft 9 5/8-in. csg @ 0 deg	Significantly reduced cost compared to gravel pack
Q2 2000 Foinaven P11	5 1/2 in., 1,800 ft 230 micron	13,074 ft 8 1/2 in. @ 90 deg	Significantly reduced cost compared to gravel pack
Q3 2000 STDQ-5	4 in., 380 ft 270 micron	11,200 ft 7 in. @ 90 deg	Production increases from larger flowing bore

joint, the EBC has the added feature of two machined profiles designed to "catch" the expansion cone at the end of its travel. A conventional Stub Acme connection looks down at the bottom.

The expansion cone is a tapered device designed to swage and expand various expandable slotted tubular products.

The cone is pre-installed inside the Expandable Top Connector (ETC), at the top of the ESS, and is driven through by the application of weight.

ESS is made from a slotted structural base pipe on which are overlapped layers of filter media and an outer encapsulating protective shroud.

The outside body of the cone has a machined groove which allows it to be shear-pinned to the ETC, and the inside has a shoulder profile which allows an expansion mandrel to engage with it.

An interchangeable hard-faced nose is used to set the desired expansion diameter prior to final assembly at the job site.

Following deployment, the Expansion Cone is retained downhole by 4 spring-loaded arms which engage within machined profiles in the Expandable Bottom Connector (EBC).

The EST Expansion Mandrel allows the transfer of work string force to push the expansion cone.

The mandrel is run on the bottom of an expansion string assembly which is essentially a BHA consisting of drill collars and/or heavy weight drill pipe.

The string design is based on the well geometry and expansion force requirements. The mandrel is of simple and strong construction.

The primary feature is a load shoulder designed to locate on a corresponding shoulder on the Expansion Cone.

Following deployment of the expanded slotted tubular and setting of the packer or hanger system, the deployment string is pulled from the well.

The expansion string is made up as previously described, then run on drill pipe until the depth of the expandable screen is reached.

By slacking off weight, load is transferred to the Expansion Cone, shearing it out and initiating expansion.

Following expansion, the cone remains down hole, and the Expansion Mandrel is free to be pulled back to surface.

CONSTRUCTION

The ESS is constructed from 3 composite layers—a slotted structural base pipe on which overlaps layers of filter media and an outer encapsulating and protecting shroud.

The base pipe is manufactured from mill-supplied pipe. Joints are cut to exact length and fully machined Super Duplex connections are welded to the pipe ends.

Joints are loaded to a fully automated pipe slotting machine, which cuts the slots over the entire length (including the connection).

A high pressure abrasive water jet cutting process guarantees "stress-free cutting," high quality and repeatability.

The box and pin connections have been designed for strength during deployment and expansion.

The intermediate layer of the ESS construction is the filter media.

This product is applied across the full length of the joint. The material can be supplied in either 316L or Incoloy 825.

An outer protective shroud ensures the filter media is not damaged when running the screens in to the well.

It also acts as the encapsulating layer, ensuring the filter media remain tightly sandwiched together following the completion of ESS expansion. ■