



Expandable Technology Forum

Date and time: 20th and 21st October 2004.

Venue: The WestLake Club, 570 WestLake Park Blvd, Houston, Texas 77079
Phone: +1 281-556-5100

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Room rate: \$79 per night (room only).
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Please book by 13th October 2004 latest, after this date availability cannot be guaranteed.

Agenda – Wednesday 20th October 2004.

	Arrival and tea/ coffee		09:00
	BP	Welcome & Introduction	09:20
1	BP	BP update	09:35
Development of the monobore			
2	Baker Oil Tools	Development of a Monobore Liner Extension System	10:10
	Tea/ coffee		10:45
3	Weatherford	Development of a Slimbore liner system	11:10
4	B Maurer	A realistic medium term (2 years) and long term "vision" for solid expandables / the monobore	11:45
	Lunch		12:20
Enabling Expandable Technologies			
5	Marinovation	Collapsed Inflatable Aluminium Shoe Joint for Solid Expandable Monobore Tubular	13:35
6	Read Group	Simplifying technology – a new approach to expandable liner hangers	14:10
7	Security DBS	Hole Enlargement Technology for the "Expanding" Market	14:40
	Tea/coffee		15:10
8	OTM	Barriers to making expandables mainstream - results of survey	15:35
9	BP	Wrap up	16:20
	Any other business		16:30



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Agenda – Thursday 21st October 2004

	Arrival and tea/ coffee		09:00
11	Welcome, intro and objectives		09:20
12	Weatherford	The use of Expandable Completion Liners and Expandable Zonal Isolation as a replacement for cased and perforated completions, (expansion of applications outside of purely sand control or drilling liners)	09:30
13	Halliburton	The Need for Annular Barrier Technology	10:05
	Tea/ coffee		10:40
14	Baker Hughes	Cased Hole functionality with Open Hole Production Capabilities	11:05
15	Terra Tek	Update of PEA 182	11:40
	Lunch		12:15
16	Weatherford	Segmentation of WFD case histories - key learning's	13:30
17	All	Operator experience of expanding screens – round table	14:05
18	BP	Wrap up	14:40
	Tea/coffee		15:15



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Presentation Abstracts

Day 1 Presentations

Welcome

BP, Mike Zhang

SET update

BP, Steve Burrows

[Development of a Monobore Liner Extension System](#)

Baker Oil Tools, Matthew Jabs

This presentation will outline the development of a monobore well system covering material selection criteria to system development including field trials. The presentation will cover the various operational and deployment developments of the system and chronicle the testing program including field trials.

Description of System

The system outlined in this paper depicts a stage approach to the monobore well program. This system allows an expandable liner to be deployed through an intermediate length casing section and expanded below this section while maintaining the same ID as the intermediate string. The system is connected to the intermediate casing string via a recess profile located at the end of the intermediate string. A top-down expansion method is used to change the casing between its run in state to its post expansion state after it has been deployed to depth.

Method of Deployment of System

The first stage of the system is to run a special recess shoe at the end of the intermediate casing string in place of the standard casing cement shoe. This recess shoe has a protective ID that prevents cement from contacting the shoe ID and is readily drilled up by standard bits.

The expandable liner is deployed in the standard manner as traditional casing with the caveat of the material and connections capable of being expanded and maintaining pressure integrity. Inserted at the desired locations in the casing string are rubber coated pipe sections which provide annular sealing capability. These rubber elements expand outward with the expanding pipe against the open hole wellbore. Future systems will allow the use of cement as the annulus sealing medium.

Expansion Method of System

Once the line has been positioned down hole, the liner is expanded top down via a hydraulic mechanical system. This expansion system is also the same tool used to carry the liner to depth. The pipe is expanded via a taper-shaped circular cone which is moved through the liner to change the liner from its run-in size to its post expansion size. The mechanism that generates the energy to move this cone through the pipe is a hydraulic piston and anchor combination. This system functions by translating the pressure applied to the wellbore drillpipe fluid to mechanical linear force via a downhole piston attached to the expansion cone. The piston-generated force is countered by a hydraulic anchor that is pressure-activated simultaneously with the piston. The anchor secures the top section of the piston to the surrounding casing and thereby provides the reaction force to prevent up hole movement of the drill pipe when the piston strokes the cone down the wellbore expanding the pipe through its stroke length.

[Development of a Slimbore liner system](#)

Weatherford, Pat York

[A realistic medium term \(2 years\) and long term "vision" for solid expandables / the monobore](#)

Maurer Technologies, Bill Maurer

[Overgauge directional drilling techniques](#)

Sperry Sun, Blaine Comeaux

[Simplifying technology – a new approach to expandable liner hangers](#)

Read Group, Paul Hazel



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This presentation describes the feasibility study for a hydraulic expandable liner hanger.

The study investigates the possibility of using HETS technology to develop a slim-well liner hanger system, which will reduce down-hole hardware whilst providing a life-of-well, metal-to-metal, load bearing and pressure tight connection. By its nature the design will allow for much smaller clearances between the existing casing and the liner than conventional hangers.

This approach offers several potential benefits. Its forward-looking design is compatible with slim-well philosophy. The fundamental simplification of the conventional liner hanger by removing packers and elastomers will provide more reliable deployment. The simpler metal-to-metal seal design should offer improved operating reliability and finally, the slim design provides a valuable intermediate casing string contingency during well construction, as well as a generally improved well design envelope (e.g. for deep water applications). The application is a development of the existing and proven methodology of the Hydraulically Expandable Tubular System (HETS) that READ is using for other expandable products and applications.

The paper considers some elements of FEA modelling underpinning the system design. The method of expansion, the manner in which the liner is hung off and cemented in place, how the hanger achieves a seal and the resulting mechanical properties of the connection are discussed.

Future development potential for this design is reviewed.

[Collapsed Inflatable Aluminium Shoe Joint for Solid Expandable Monobore Tubular](#)
Marinovation, Philippe Nobileau

[Hole Enlargement Technology for the "Expanding" Market](#)
Security DBS, Gary Clemens

Hole enlargement is a key factor to the success of running expandable tubulars or screens. The completion of the job depends heavily on the quality of the planned borehole enlargement required.

Over the past 5 years there have been significant strides in hole enlargement tool development in a focused effort to improve effectiveness and economics. The primary goal has always been threefold; drill the pilot and open the hole in one pass to minimize trip time, have the HE (hole enlargement) tool last as long as the rest of the BHA and produce a quality hole. The majority of the efforts have focused on more typical simultaneous hole enlargement applications where holes are enlarged on the order of 18-22%. Actual enlargement capability varies from design to design and is dependent on specific size of the tool and design based on formation conditions. Some of these tool designs were detailed in a presentation at the ETF in Rijswijk in April, 2004.

The increased use of expandable tubulars and in particular Monodiameter technology has created new challenges that current tools do not compliment and mandated the need for new Hole Enlargement technology and products. Over the past 6 months, two new simultaneous, concentric hole enlargement products have been in development. The first tool provides similar hole enlargement size as current technology but incorporates unique design changes that address some of the industry identified needs for more reliable and efficient tools for these applications. Patent pending features insure cutter arm activation and deactivation as well as the ability to lock the arms closed. This feature is needed when drilling ahead with the pilot bit only or when circulating at high flow rate inside the casing or other restriction. The second tool incorporates much of the similar design features but is able to simultaneously enlarge up to one and one half times the pilot hole. Today's technology limits these needs primarily to underreaming tools which typically requires two passes and two trips to complete the hole enlargement.

This presentation will review the ongoing hole enlargement work being done to insure compliance with current expandable technology and detail some of the new designs being developed to address the ever changing market.

[Barriers to making expandables mainstream – results of survey](#)
OTM, Shreekant Mehta

Day 2 Presentations

[The use of Expandable Completion Liners and Expandable Zonal Isolation as a replacement for cased and perforated completions, \(expansion of applications outside of purely sand control or drilling liners\)](#)
Weatherford, Pat York



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[The Need for Annular Barrier Technology](#)
Halliburton, Randy Simonds

The ultimate goal of sand control completions is the delivery of not only reliable sand control, but also cased hole functionality in an open hole environment. This capability is only possible when reliable annular isolation is available. While isolation of the screen from the production tubing (internal isolation) is needed, reliable means to achieve it are readily available with conventional technology. Providing isolation in the open or cased hole and screen annulus (external isolation), however, requires different technology. The technologies discussed in this document deal exclusively with devices to achieve reliable external isolation.

The presentation will provide information on three different external annular barrier technologies available commercially. Which technology is selected depends upon a variety of factors, including anticipated borehole quality (i.e., how relatively gauge is the hole and how washed out it is expected to be), pressure differential between zones, and type of isolation required.

Fixed Reach Annular Barrier Tool (ABT -FR)

An ABT-FR is comprised of a joint of expandable blank pipe (no perforations) having a section of elastomers bonded to the OD. The elastomers are machined to a proprietary pattern to allow reliable expansion in gauge or relatively gauge holes. As the expansion cone passes through and expands the blank pipe, the elastomers are expanded, creating a reliable seal with the borehole.

Variable Reach Annular Barrier Tool – Mechanical (ABT -VRM)

An ABT-VRM is comprised of a joint of expandable blank pipe with an outer compliant cylinder placed over the OD. The annular space is filled with a fluid inert to the formation. The cylinder is pre-formed and coated with an elastomer. As the expansion cone passes through and expands the base pipe, the pressure inside the fluid chamber increases. At a pre-determined pressure, the cylinder expands to a much greater extent than does the base pipe. This enables the compliant chamber to form an effective external annular seal in over gauge and irregularly shaped boreholes.

Variable Reach Annular Barrier Tool – Chemical (ABT -VRC)

An ABT-VRC is actuated and constructed in much the same way as is the ABT-VRM, with one important difference. In this version, the annular space is filled with a proprietary fluid designed to bond with elastomer, rock, and steel. As the pressure in the fluid chamber increases during expansion, a relief valve opens which vents the fluid into the external annulus. The fluid then forms a strong bond with the formation, compliant cylinder and elastomeric coating. This enables the compliant chamber to form an effective external annular seal in over-gauge and irregularly shaped boreholes much like the ABT-VRM. However, the novel fluid has a Poisson's ratio similar to that of standard packer elements, thus enabling this version of the tool to withstand a higher differential pressure rating. An ABT-VRM is run in conjunction with an ABT-VRC to ensure the sealing fluid is diverted into a confined space in the annulus. This ensures more reliable displacement of the wellbore fluid from the space, which enhances the seal with the wellbore.

The primary need for external isolation is to allow injection or production selectivity between zones. Such zones are most often separated by shale sections, which can have a variety of net to gross ratios. While the shale may have low permeability relative to the bounding sandstones and thus cannot be produced through or injected into, the general impact of exposed (non-isolated) shale is a decrease in completion reliability.

The failure of shale detrimentally impacts completion reliability for a variety of reasons. The behavior of shale in a producing environment has not been rigorously characterized in the industry; however, while study in this regard is ongoing, the mechanisms can be grouped into three major categories.

- **Mechanical failure:** Shale fails in the near wellbore region in much the same way as sandstone. The accompanying dilation of the rock (volumetric increase) places a collapse load on the completion. Given that shale does not tend to form a stable arch when failed in this manner due to the greatly reduced friction angle (relative to those in failed sandstone) the force is transmitted directly to the screen.
- **Chemical incompatibility:** That many shales are reactive to drilling fluids is well known in the industry. However, the interaction between shale and produced fluids is less well understood. Completion fluid, produced hydrocarbons, and water can all cause swelling of the shale, increasing its volume, which decreases its strength. This accelerates near wellbore mechanical failure of the rock.
- **Pore pressure containment:** A certain amount of confining stress is present bounding the shale section due to the pressure in the adjacent sandstones. As the sandstone is depleted, this confining stress is lessened or removed, which allows the shale to swell mechanically, again increasing the amount of failed material.

In all these cases the result is either an increased collapse load on the completion, which can result in catastrophic failure and the possible loss of the well, or severe screen plugging due to the tendency of some shales to behave as fluids when failed, rather than as "rubble". In either case, the longevity or reliability of the completion is compromised.

For this reason, the installation of reliable, effective external annular isolation is critical not only to allow multi-zone selectivity, but also to protect completion reliability by isolating sections of the wellbore with less desirable net to gross ratios, allowing relatively cleaner sands to produce (or inject) to their potential.



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[CNOOC SES Ltd. Experiences with expandable screen for sand control device](#) CNOOC, Rafli Putra

In South Business Unit (SBU) - CNOOC SES Ltd. our main producer is The Talang Akar Formation (TAF), which is a typical sand stone. Since production started in the early 70's, this reservoir is now considerably depleted. A depleted reservoir combine with the un-consolidation generates significant amounts of sand production. We recognize this phenomenon in our wells and we will continue producing sand compromising our Electric Submersible Pump (ESP) run life if sand control is not used in our problem wells.

Since 2001 we have been installing Expandable Sand Screen as a sand control technique/technology, which has shown encouraging results in term of production and pump run life. From 15 workover wells in cased hole and 5 new completion/re-completion wells in cased and open hole already installed we have tremendous improvements in oil production and our ESP run life, mechanical failures include 1 job fatal failure during expansion process, 3 job failures with connections parted during expansion process but did not affect the production rate post installation and 2 wells which failed after installation.

For short interval as required in SBU wells, the cost is competitive with the frac pack system. It is still required to place some gravel behind pipe to fill any possible void to Prepack the formation and/or prevent the perforations tunnels to get plugged after we installed the ESS in the workover wells. By installing this sand exclusion device we successful prolong the ESP runlives even though some sand production is still shown from some of wells.

[Cased Hole functionality with Open Hole Production Capabilities](#) Baker, Jim Montagna

The Expandable Sand Control technology recently acquired interest from operating company having proven its reliability in various environment and configurations. Both mechanics of deployment operation and fluid handling procedures have been validated and consolidated through field runs, showing dependability, improved logistic efficiency and overall performances comparable with standard operations. These results confirmed margins to enhance the project targets to high complexity scenarios and encouraged widening the candidate selection criteria towards more demanding environments.

To progress on this direction, the client identified an opportunity to further challenge the advantages of the expandable sand screens technology in a gas storage well open hole sidetrack. This application required deployment through a milled window of a screen assembly to provide necessary sand control for the target zones as well as isolation of upper shale and shale breaks located between the sands.

This paper will demonstrate how the various challenges have been faced and solved through planning and execution, specifically in the following areas:

- ^a wellbore construction options (*this workover would have been more expensive or less productive with standard practice*)
 - ^a fluid procedures (*this application required to take into account a shale section*)
 - ^a one trip system reliability (*expansion through a milled window: consideration on bent angle, whipstock inclination, rubber element to drift a milled iron section*)
 - ^a zonal isolation requirements (*we have production data to show*)
 - ^a sand retention capabilities of the screen (*we have sieve analysis, or better a lot of historical field data and sampling wireline run to prove expandable sand control*)
 - ^a production enhancement (*the original open hole section was abandoned for screen failure, our producing bore is just few degrees distant from the original one so we can compare this installation with the production data from the original open hole gravel pack*)
-

[Segmentation of Weatherford case histories – key learning's](#) Weatherford, John Cameron

[Update of PEA 182](#) Terra Tek, Arnis Judzis



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The goal of PEA 182 is to reduce risks associated with the installation and use of expandable screens. In its second year, 12 project sponsors (8 operators, 4 service companies, 2 other operators now pending) are using the results of the Reliability Studies and issue of Functional Requirements to focus on testing that will allow use of expandable screens in even more severe applications. The project's Functional Requirements cover technical specifications for sand control, annular isolation, liner hangers, blank pipe, etc. that enables operators to compare performance across a variety of completion methods and suppliers.

In discussion are protocols for the testing of materials, including higher alloys, to understand the longer-term serviceability issues for cold worked metals. The Functional Requirements for expandable screen completions include "Materials of construction must be compatible with in-situ well conditions". Also being developed are protocols for testing of sand retention performance under downhole conditions. Operators sponsoring PEA 182 have had various in-house and contracted techniques to best pick screens, however these methods may be rationalized to develop improved test procedures.

[Operator experience of expanding screens – round table](#) [All operators](#)

Operator views on:

1. Status of existing installations
2. Lessons learnt/ outstanding issues
3. Expanding screen strategies
4. Planned installations/ timetable
5. Main technology challenges/ shortfalls