Expandable tubular technology gaining in popularity

EXPANDABLES THROUGH CASING

DURING DEVELOPMENT, THE potential of solid expandable tubular technology promised to revolutionize the design, construction and remediation of wells through conservation of hole size and maximization of pass-through and flow areas, as well as lengths. The increased use of this technology by major and independent operators is proving this promise true.

The expandable metal cladding system is deployed and expanded utilizing an innovative hydraulic piston/anchor system that allows flexibility in the length of the deployed clad from short sections to unlimited lengths, providing re-lining of casing with pressure integrity in a one-trip system. IADC/SPE 87212

Operators are realizing significant value creation in new well construction and increased production from remediated wells.

Initially, the envelope of well criteria in which solid expandable tubular systems were qualified was limited to relatively straight holes. Currently, the performance of solid expandable tubular systems is proven for use in high-angle and horizontal wells, ultra-deepwater and deepwater wells, multiple installations in the same well, nested-installation situations that require a relatively long expandable casing string (over 6,000 ft), various cementing options, and more. Recently, the viability of installing and expanding through a milled window was proven for a major operator in the Gulf of Mexico.

The authors will discuss the planning and attention to detail to ensure the reliable installation of solid expandable tubular systems through a milled casing window into a sidetrack or lateral wellbore, the procedures used to test performance and the results of surface and field testing. The current limitations of using solid expandable tubular systems in this application will also be presented.

Installation of Solid Expandable Tubular Systems Through Milled Casing Windows (IADC/SPE 87208) **K K Waddell**, **Enventure Global Technology**; **R Schuurmans**, **Shell Exploration and Production**.

SOLID EXPANDABLE TUBULARS

Many modern well construction techniques have been developed with an eye toward drilling deeper, longer, more cost effective extended reach drilling (ERD) wells. Solid expandable tubulars is one such technology, developed specifically to allow additional casing strings to be run to cover up problem zones to facilitate drilling a well to the ERD target.

They were also developed to reduce the overall resources required to construct the well. The size or volume and cost of the rig, the drill string, the bits, cement, and the casing were projected to be reduced significantly, resulting in lower overall cost. These projections have substantially occurred and will culminate in the mono-diameter well to be described elsewhere.

The expected benefits for ERD wells will be significant, but there are important side effects that can have a profound cumulative effect. The torque and drag on an ERD well is usually the limiting factor in the reach that is actually possible. These effects are mitigated through control of drilling fluid properties and through the use of rotary steerable drilling tools among other technologies.

The use of solid expandables has two distinct effects that can be favorable for drilling ERD wells. The surface roughness of post-expanded, solid expandable tubulars, by the nature of their manufacturing requirements and forming techniques, will usually be substantially less than the roughness of comparable seamless casing.

The second, and far more important effect, is that a more favorable drill string/casing geometry that can reduce the tendency for helical buckling or drill string lock up is possible.

The author will examine data supporting the positive effect of solid expandable tubulars on drill string torque and drag. Surface roughness data and frictional effect data from drilled wells will be presented. This data modeled for an ERD well shows the theoretical drilling limit improvement from these effects in real example wells.

Breakthroughs Using Solid Expandable Tubulars to Construct Extened Reach Wells (IADC/SPE 87209) **K L DeMong**, **Halliburton Energy Services**; **W Rivenbank**, **Enventure Global Technology**; **D Mason**, **Shell Advanced Technology Group**.

CEMENTING EXPANDABLE LINERS

The oil and gas industry has an established set of good cementing practices to meet the overall objectives of cementing. These practices have been refined and perfected over decades of industry experience in the discipline.

However, the new technology of expandable liners brought about its own set of cementing issues and requirements based on the equipment design constraints. Some of the requirements run counter to the established good cementing practices.

The authors will discuss some of the new cementing issues and requirements for expandable liners and their implications on the overall effectiveness of the cement job. Optimizing the cement job involves addressing the issues and tak-

ing a compromise between the new cementing requirements and the established good cementing practices. The authors will also discuss some of the available solutions for the cement job optimization with a view to meet the overall cementing objectives.

Finally, a case history where the above has been successfully implemented will be presented and discussed.

Issues and Solutions for Cementing Expandable Liners-A Case History (IADC/SPE 87211) **R A Rahman**, **BJ Services Company**; **C K Mazuan Ahmad**, **Petronas Carigali Sdn Bhd**.

EXPANDABLE CLADDING

Metal cladding, which has been used to repair oilfield casing for a number of years, is limited by several factors including length, pressure integrity and robustness.

A new, highly robust, expandable metal cladding technique is available that provides true re-lining of extended lengths of casing with pressure integrity in a one-trip system. The author will describe the system, explains how it works, and presents a case history of the technique's first application in June 2003.

The objective of the project in central Oklahoma was to repair a section of casing in a 1950s oil producer that was damaged from casing collapse that occurred when an offset injector well went on line and failed the existing casing section. Approximately 675 ft of expandable metal casing cladding was installed inside 7-in. casing with the expansion process completed in 3 ½ hours.

The clad was deployed at a starting depth of approx. 3,800 ft in a vertical well section and with an ending depth of approximately 4,475 ft in heavier weight 7-in. casing.

The technology presented provides operators with the ability to create a definitive casing repair with pressure integrity and minimal well restriction.

The system is deployed and expanded utilizing an innovative hydraulic piston/anchor system that allows flexibility in the length of the deployed clad from short sections to unlimited lengths. The author will outline the unique aspects of this new technology, covering its possible applications as well as technical deployment details.

New Expandable Cladding Technique Enables Extended-Length Casing Repair (IADC/SPE 87212) **M J Jabs**, **Baker Oil Tools**.

PRESSURE INTEGRITY

The authors will discuss a new technology for evaluating high pressure gas seal integrity of polymer ring seals used as secondary of backup pressure seals in casing and tubing threaded connections. This new technology may also enable the further consideration of API connections with ring seals as an alternative to premium connections for appropriate applications.

During makeup, the ring is deformed from its original rectangular cross section to its final shape, and contact pressures between the ring seal and thread surfaces are computed. After makeup, axial loads are applied, along with elevated temperature and internal pressure.

Models were constructed using API Spec 5CT maximum and minimum permissible ring seal and coupling groove dimensions. The smallest volume ring seated in the largest groove produced very low contact stresses, which may make the connection susceptible to gas leaks.

The largest volume ring seated in the smallest groove gave much greater contact pressures, but pin and coupling stresses were very high in the ring vicinity.

In addition, since the coefficient of thermal expansion of the Teflon is an order of magnitude greater than that of steel, contact stresses increase significantly at elevated temperatures.

Also, since the stiffness of Teflon decreases significantly with temperature, the ring seal material deforms and relaxes more significantly at elevated temperature.

Evaluating Pressure Integrity of Polymer Ring Seals for Threaded Connections in HP/HT Wells and Expandable Casing (IADC/SPE 87214) **L B Hilbert**, **J Bergstrom**, **Exponent Failure Analysis Associates**; **E P Cernocky**, **Shell E&P Technology**.

SAND CONTROL

Firm commitments to deliver relatively large volumes of oil and gas require thorough understanding of the risks and uncertainties associated with two main sand control options, gravel packing in open hole and the expandable sand screen applications in reservoirs to guarantee security of supply.

Historical production, sand failure prediction, inflow/outflow, plus economic models were employed to assess the pros and cons of both completion techniques considering reservoir management, productivity, sand control reliability and implementation.

The historical production model examined the effect of off takes on reservoir pressure, water and gas breakthrough and investigated potentials for good reservoir management. Sand failure prediction model helped to support early decision-making, which could provide scope for optimization and cost reductions in the field development plans.

The expandable sand screen has a more even inflow, which has several advantages in terms of reservoir management:

• Production rates considerably more than gravel pack rates;

* Reduced and more even drawdown for production along the wellbore length (less prone to sanding and better mud-cake lift off;

• Even production inflow giving more efficient reservoir drainage;

• Reduced risk of early water and gas breakthrough;

• Well slimming.

The results of all the models fed into the economic model to assess whether the completion costs lead to increased productivity and whether significant increases in PI justify added cost.

Expandable Sand Screens or Open Hole Gravel Pack? Modeling for a Beter Sand Control Option (A Niger Delta Study) (IADC/SPE 87215 – Alternate) **J O Arukhe**, **K E Adowei**, **U E Ebong**, **T Meijssen**, **A F Abiodun**, **Shell Petroleum Development Company, Nigeria**; **L Nwoke**, **C V Uchendu**, **BJ Services Nigeria**. ■