



World Energy Interviews Craig Hendrie, President, Plexus Deepwater Technologies

World Energy: Can you give us a little background on your company?

Hendrie: Plexus started in 1982 in Aberdeen, Scotland, with an initial focus on mudline suspension equipment and adjustable surface wellheads for jackup rigs. Plexus products were always innovative with functionality and high-quality engineering in mind – designed from the ground up to be the best solution for the task at hand, and not just following standards or trying to copy conventional technology. I joined Plexus in 1997 and was attracted to the company because of its reputation for innovative design and success at bringing step change products to market. We've always focused on the most challenging engineering problems and enjoyed coming up with solutions. I think one of the keys to continued innovation is that the company is still run by engineers.

World Energy: What have your most recent developments been?

Hendrie: In 1997, we had a fair amount of capital to dedicate to researching new technology for wellheads. Our initial goal was to come up with a simple and robust design for an adjustable or tensionable "through the blowout preventer" [BOP] wellhead, which means that casing strings and seals could be installed, secured and tested all without lifting the BOP as is necessary with standard "slip and seal" technology. What gradually took shape out of this exercise is what we call POS-GRIP technology,

which is certainly our most important recent development.

World Energy: So what is POS-GRIP and how does it work?

Hendrie: POS-GRIP is a very simple way of supporting a hanger in a wellhead through friction. With a simple hydraulic system on the outside of the wellhead housing, we elastically deflect the wellhead bore inwards to grip and seal against the hanger on the inside (Figure 1). There are two major classes of traditional wellhead systems: "slip-and-seal" wellheads, which require the removal of the BOP to suspend the casing on slips and effect a seal, and "unitized" wellheads where a casing hanger lands on a shoulder so no casing tensioning or adjustability can be achieved.

We see POS-GRIP as a new dimension in wellhead design which combines the advantages of both types of the traditional systems along with some new aspects which are particularly advantageous as we move towards higher temperature and pressure developments. When temperature and pressure changes occur, metal-to-metal seals in conventional wellhead systems undergo substantial variations in contact stress, which leads to failure of the seal after a certain number of cycles. The POS-GRIP solution does not require the removal of the BOP, but it does allow the space-out and tensioning of inner strings. The action of squeezing everything together creates a preload between

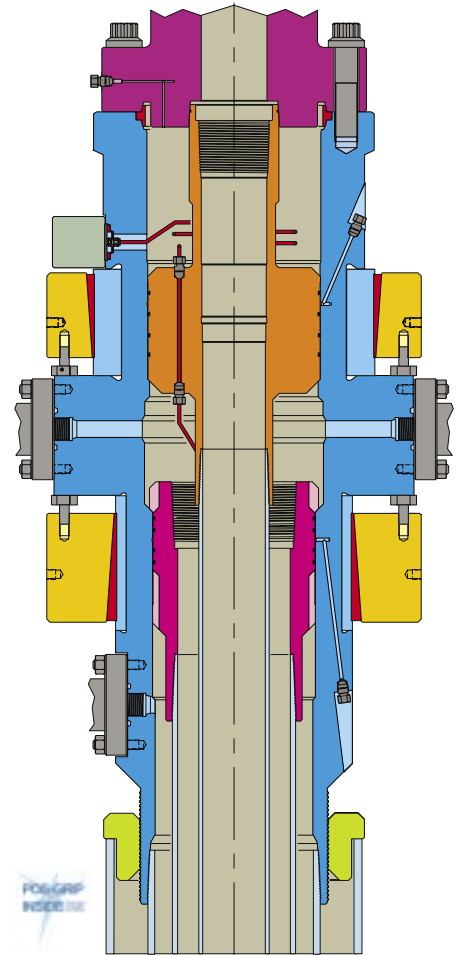


Figure 1: POS-GRIP™ is a method of supporting oilfield tubulars with an externally activated friction grip. In a POS-GRIP wellhead, the bore is elastically deflected inwards to grip and seal against an internal casing or tubing hanger.

components, which eliminates any relative motion due to the pressures and temperatures in the system (Figure 2). This results in seal systems with higher reliability on initial installation and throughout field life.

World Energy: What development and testing has been completed?

Hendrie: POS-GRIP is now a mature technology, which we have successfully applied to a number of different products. Obviously a lot of development and testing has been done since our first experiments with this technology in 1997. After some initial commercial success, we undertook a major R&D effort, which was sponsored by two major oil companies, where we spent a lot of time and effort

doing some of the "high science" work to understand exactly how this technology works. This was dubbed the "Prove the Science" project, and it went above and beyond the standards generally required for this type of product development. We have now supplied POS-GRIP products for over 60 wells worldwide.

World Energy: How does POS-GRIP enhance rig safety?

Hendrie: First and foremost, POS-GRIP is a "through the BOP" technology. Furthermore, the improvement in seal quality assures much higher seal reliability for HP/HT and ultra high-pressure and temperature (UHPT) wells up to 30,000 psi and 450 degrees Fahrenheit.

World Energy: How does your technology help in high-pressure/high-temperature applications?

Hendrie: With POS-GRIP we can seal directly between a hanger and the wellhead bore by squeezing the two together with very precise preloads and over a much larger area than is provided by conventional metal seal designs. This means that a much wider seal band needs to be destroyed before a seal fails. But more importantly, the actual effect that high pressures and temperatures have on the component interface is greatly reduced, because everything is already preloaded together. That means there is much less potential for relative movement at the seal

interface, so the mechanism which normally wears down the metal seal is virtually eliminated. Another feature is that POS-GRIP requires no landing shoulder, so casing or tubing can be precisely tensioned without lifting the BOP.

World Energy: What is the cost premium for the POS-GRIP technology?

Hendrie: POS-GRIP is actually a very simple technology, and POS-GRIP products compete very favorably in all parts of the market. In certain applications, the time savings associated with the "through-BOP" feature mean that the total installed cost of the equipment is actually significantly lower than competing technology. At the high-performance end of the market, POS-GRIP products retain their simplicity, and the capital cost of the equipment can be lower than the equivalent product that it replaces. As acceptance of the technology grows and manufacturing volume increases, POS-GRIP will become competitive with lower-spec systems and begin to replace technology even where metal seals or time savings are not critical.

World Energy: What other applications do you see for this technology?

Hendrie: The obvious targets are wellhead applications right across the board – I've already mentioned HP/HT surface wellheads and mainstream low-pressure wellhead

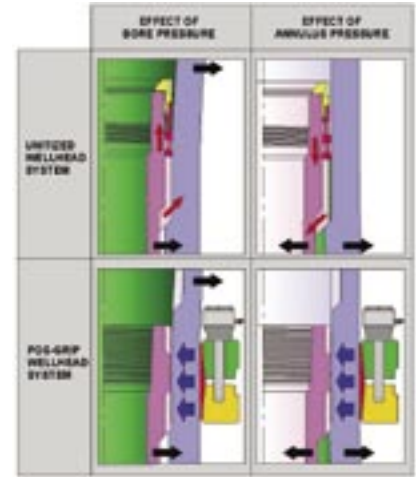


Figure 2: POS-GRIP positively preloads the seals from the outside, so stress variations at the point of sealing are greatly reduced, and relative movement is eliminated.

systems, but we have also identified enabling advantages in subsea, deepwater and surface BOP applications. But POS-GRIP also makes a great fatigue-resistant, reusable connector suited to drilling risers, space-out joints, pipeline and jumper connectors. In fact, any application which requires the joining of concentric tubular members or requires high-strength remotely operated connectors could benefit from POS-GRIP.

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