Repairing Subsea Pipelines Without Welding

Many of the world’s oil pipelines and platforms are approaching the end of their designed life. Repairs are likely to take up an increasing percentage of maintenance budgets in the near future. But how best to make those repairs? Here we put the case for mechanical connectors rather than welds. Many of the world’s oil pipelines and platforms, from Europe’s North Sea to India’s ‘Mumbai High’ field in the Gulf of Khambhat, were brought into service in the 1970s and are now approaching - and in some cases have already gone beyond - their intended life.

In the North Sea, for example, where there was a massive expansion of oil and gas production when the West’s demand for oil rocketed with the rise in national incomes and consumer wealth, up to 15 per cent of subsea pipelines are now beyond their intended life; within three years the proportion will have risen to 25 per cent.

So repairs are likely to take up an increasing percentage of maintenance budgets in the immediate future - especially since inspection and management is also now driven not just by good practice, but also by the political pressures that have followed well-publicised national and international accidents and spillages. The likelihood, therefore, is that a lot of corroded pipelines will need a lot of repairs within the next few years. A leaking subsea pipe isn’t something you can ignore until the next round of maintenance, and the unscheduled shutdown can cost vast sum of money.

But how to repair? That is the question.

In shallow water, welding is usually - but not always - the obvious way to go. The techniques are familiar, there is a lot of expertise and the pressures on pipelines from external forces aren’t as great. Another possibility is wrapping with composites and epoxy materials, though as far as we are aware this is limited to smaller local repairs. No one has tried this at greater depths and the body of knowledge about the longevity of such repairs makes it less likely that anyone will risk it, at least until major standards agencies have tested it more thoroughly.

In deeper water, welding remains the principal method. Up to a couple of hundred metres, direct welding by divers is relatively simple to organise. Once we get beyond that depth, the problems of welding grow significantly: the need for hyperbaric chambers, specialised rigs, the necessity of hot-pipe work and not least metal and arc degradation, which tends to mean repair welds are rarely as long lived as the original ones, all play their part.

This means that the financial and speed advantage welding has over other forms of repair at shallow depths starts to dissipate: at greater depths mechanical connectors start to become a far more attractive proposition. Over the period Mumbai High has been actively exploited, mechanical connectors have become an increasingly popular tie-in method.

Such connectors had been around since the 1920s, but by the Seventies were barely suited to the pressures in use in the major lines then being laid. Many had sealing problems that made them unreliable for high pressures, and even worse, seals were often made of inflammable materials, making them unsuitable for any kind of oil or gas work. But over the past 30 years much work has been done both to make systems more reliable and to develop new sealing materials. Hydratight, for example, has led the field in graphite sealing systems, which overcome many of the fire-safe and shelf-life disadvantages of the polymer and elastomeric seals in common use.

As late as 1999, engineering papers routinely dismissed - though with grudging recognition - the general use of mechanical pipe connectors. They weren’t as strong as welds, the belief went; neither did the mechanical systems used to install them have the kind of metrological accuracy needed to line-up pipes and connectors with certainty that no damage would be done to either; or that the pipework would be held straight and true and avoid undue strain. Welding, it was argued - even diverless - remained the better option, a position that still remains entrenched in some corners of the industry. In fact, systems such as Hydratight’s MORGRIP connector have been refined to the point where they are not only as strong and safe as welding, but offer considerable benefits in deep-water oil and gas exploitation.

Over the past 15 years various makers, including Hydratight, have developed mechanical systems that offer connections of at least the equivalent joint strength to welding, that are in every case less damaging to the metal structure of the joint, and which are far more placement-tolerant. Indeed, modern diverless connection methods for welding or mechanical connection use the same highly-accurate DP and GPS systems that weren’t available to engineers a decade ago.
But can mechanical systems do the work of typical welded ones? Do they offer any advantages?

To answer the first question, yes they can do the work of welds. Hydratight’s own MORGRIP range is certified in place of welds (DNV, Lloyd’s, API, ABS, ROK) on pipes up to 42 inch diameter and on pressure ratings up to 2,500lb ANSI, and provides a joint as strong as a weld. The range’s designed connection life is at least 30 years; Hydratight has installed approaching 2,500 connectors around the world in the past two decades, many of them diverless, and they have a 100 per cent leak-free record.

Do mechanical connectors they offer advantages over welding? Often, yes. The supposed advantages of welding at shallow depths recede rapidly as the water gets deeper. Mechanical connectors require no hot work, which means no special permits; they cannot introduce the common problems of welds, such as hydrogen or oxide contamination, or slag, they are easily pressure-tested (in fact some types have pressure-test facilities built in), they require no specialised prep tools or careful shaping of the joint, and most importantly, they come without the ancillary demands of welding - the welding equipment, the creation of a hyperbaric habitat, the specialist personnel required to produce top-quality welds in difficult conditions, and the extensive inspection and testing regime that follows completion.

Many of the more forward-thinking oil companies and specialist pipe welding analysts now hold stocks of their favoured mechanical system, in varying sizes, to provide fast repairs when emergencies strike. Others have taken to routinely using mechanical connection for lines that need to be fixed then rebroken: one of the biggest advantages of mechanical connectors is that they can be reused many times, while welds are strictly a one-time event.

When all is considered, mechanical connection is a technology whose time has come. In the past decade the advances made in systems, seals and compression methods has brought mechanical connection not only up to, but in some cases beyond, the capabilities of pipe welding, both subsea and topside. For those applications for which it is best suited, mechanical connection can be faster, safer and more cost-effective - a powerful argument in their favour.

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MORGRIP was used in the divelasser repair of a 30 inch, 210bar pipe, 200 metre down in the North Sea Norwegian sector. The pipe - the link between two large platforms and the shore - demanded a complex repair involving a new section of pipeline and two large MORGRIP connectors, manoeuvred into place from steel frames in an intricate operation using GPS and remote cameras. The pipe was buried in concrete and asphalt on the sea bed, and had been damaged by a ship’s anchor.

The seabed was first cleared, then 100-tonne, H-frame rigs were lowered to hold the severed ends of the pipe. These held and roughly manoeuvred the ends into position using GPS and remote cameras.

A separate, high-accuracy connector installation frame was then lowered to the sea bed holding a new 25 metre section of pipe with a MORGRIP connector on the end. The two ends were carefully aligned inside the connector and the actuators energised. The procedure was then repeated at the other end.

An example of the speed of fixing achievable with modern connectors comes from Hydratight’s experience using MORGRIP on a North Sea gas platform. Estimated welding time for four two-inch flange adaptors was 50 hours, added to around 240 estimated hours for another five 12 inch couplings and one flange adaptor. The most experienced welding teams might have reduced this a little, but using MORGRIP the work was completed in 70 hours, and with fewer personnel. This was a significant saving to the overall platform downtime.

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