

# Improving the bottom line of oil & gas developments

*With the recent upheavals in the industry caused by the low and/or unstable crude prices, operators are searching for new ways of reducing operating costs and getting a better return from their investment capital. In the following, Wenco's Archie Hyde explains that Ameron, in conjunction with British Aerospace, have jointly developed a hybrid high pressure pipeline system that will have major implications for improving the bottom line of oil and gas developments, especially for marginal subsea applications.*

The new pipeline system is now known as Bondstrand® Steel Strip Laminate (SSL) and is a hybrid of technologies used in both aerospace and oil & gas industries for more than 20 years.

## Bondstrand history

With the end of the cold war in the late 80's, British Aerospace's Royal Ordnance Rocket Motors Division was looking for ways to commercialise their composite rocket motor casing technology in new markets to reverse the effect of a shrinking defence budget.

At the same time, Ameron was looking into ways of reducing the cost of their high-pressure glass reinforced epoxy pipeline systems.

Both parties recognised the potential synergy of their respective technologies and set about developing a pipeline system that would not only withstand extremely high pressures and ballistic damage, but would

not suffer the corrosion problems which most infield pipelines are beset with.

This development phase has been extensive and after approximately eight years of developmental research, SSL is now ready for production.

## Pipe wall construction

The structure of the pipe wall is designed to cross comply with the requirements of API-15HR and API-5L with respect to the individual components of construction.

A cross section of the SSL pipe wall construction comprises:

- Inner pipe wall - a pressure seal of epoxy resin-rich glass reinforced liner;
- Layer 2 - structural section of filament wound glass reinforced epoxy;
- Layer 3 - structural section of high tensile strength MartINsite™ steel strips helically wound into the pipe which is laminated and encapsulated by epoxy resin;
- Outer jacket - a section of filament wound glass reinforced epoxy.

The pressure rating of the SSL pipe is varied by the number of steel strips in the wall i.e. - 200 NB SSL pipe rated at 330 bar will require 10 strips, whereas the same diameter rated at 125 bar will only require 3 strips.

When compared to homogeneous high pressure glass reinforced epoxy (GRE) pipe of the same pressure rating, the addition of the high strength steel strip means the SSL pipe requires a wall thickness less than a third of the GRE pipe, thus substantially reducing the amount of the epoxy resin required. The SSL pipe also has the same degree of corrosion protection as the GRE pipe.

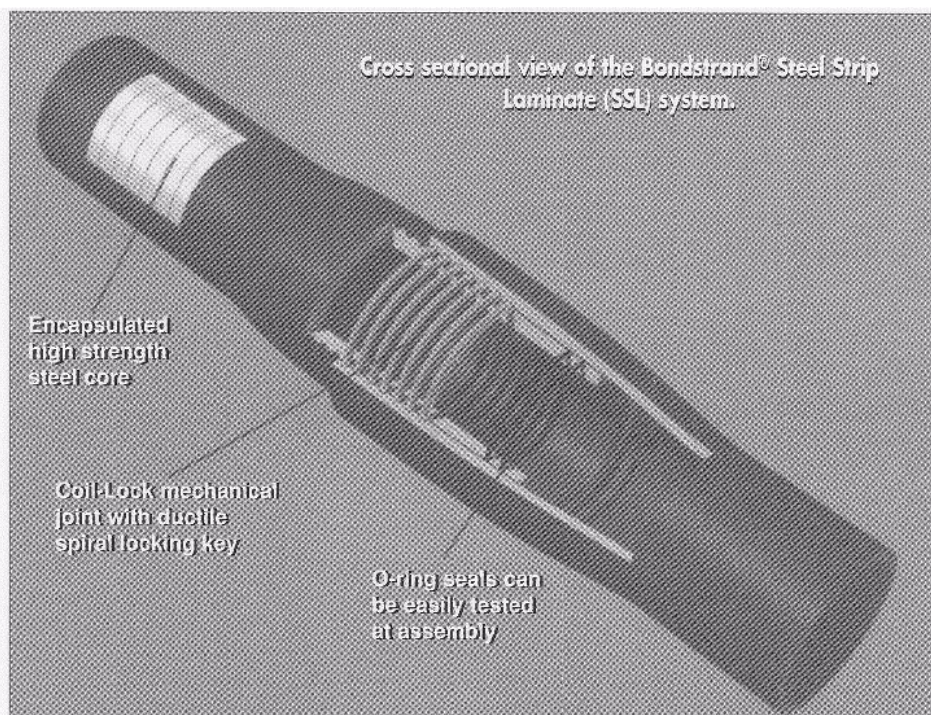
The SSL pipe has a safety design factor that exceeds API 5L requirements by 20%, with maximum pressure ratings ranging from 330 bar @ 200 NB to 70 bar @ 1000 NB.

Temperature rating of the pipes range from 21°C - 93°C and higher temperatures of up to 11°C can be achieved.

SSL is only available in sizes from 200 NB up to 1000 NB. For sizes below 200 NB standard high-pressure GRE pipe can be economically utilised.

The standard manufactured length of SSL pipe is 11.89 metres and special lengths are available for tie-ins.

The pipe weighs approximately 60% less than an equivalent rated corrosion resistant alloy pipe and is easier and less complicated to handle.



## PIPING TECHNOLOGIES

### The Joining System

The Coil-Lock joint is a hybrid design derived from the time proven ability of Ameron's Key-Lock joint being converted to a helical coil configuration for high pressure performance.

The completed joint consists of an integral female tapered socket which houses a nylon or pure aluminium bearing that mechanically locks the tapered male pipe end in on make-up.

The joint is hydrostatically scaled by means of a standard double elastomeric O-ring. The seal of the O-ring is tested for proper fit by a sample air test.

For critical applications, such as highpressure gas, a polysulphide or polythioether adhesive sealant can be injected between the double O-rings. This sealant can be radiographed to ensure the bonded area between the O-rings is complete.

The Coil-Lock joint has a design safety factor of 4:1 and displays excellent performance when subjected to severe internal and external forces. joint make-up is fast, uncomplicated and, as such, only requires a small crew (2-3 people).

### Corrosion Performance

SSL performance is excellent in services where the high levels of CO<sub>2</sub>, H<sub>2</sub>S or Sulphur Reducing Bacteria are present.

The inner liner of glass reinforced epoxy provides an impenetrable barrier that fully protects the MartInsite steel strips. The outside layer of GRE protects the same from external environmental corrosion.

Cathodic protection or chemical injection is not required to prevent corrosive attack on SSL. This represents substantial cost savings on both Capex/Opex. The use of intelligent pigs is also no longer required.

Extensive accelerated long-term corrosion testing of SSL pipe has been undertaken over the past five years, with excellent results.

This, combined with Ameron's 40 years of experience with GRE pipe in corrosive oilfield environments has lead to the belief that SSL will have a life expectancy at least

equal to the design life of the development, with minimum or no maintenance required.

### Installation

For onshore pipelines, there is little difference between the installation processes (other than jointing) of a FBE coated API 5L line pipe and SSL.

SSL cannot be bent at location like the steel pipe, so changes in direction are accommodated by the minimum bending radius of the SSL pipe or by filament wound elbows. SSL can be buried or run above ground on supports and can be tied into steel lines using ANSI flanged adaptors. Subsea installation of SSL can be by S-lay, J-lay or tow methods.

A recent study on the installation of a 200 NB SSL 10 pipeline compared with API-5L-X52 14.27mm wt pipe showed that:

- Maximum allowable installation loads for the SSL and steel pipes are of similar magnitude and are based on similar factors of safety. The axial load capacity of the steel pipe is 20% higher than for the SSL pipe, but the bending capacity of the steel pipe is 12% lower:

- The weight of SSL pipe is considerably less than the weight of steel pipe; hence installation loads on SSL pipe should be considerably lower than for steel pipe;

- The steel and SSL pipes show similar Vortex Induced Vibration (VIV) behaviour. For both pipes, critical span lengths are in excess of 20 metres even under extreme environmental conditions. To minimise the risk of fatigue, damage steps should be taken to ensure span lengths in excess of 20 metres cannot occur;

- Neither steel or SSL is expected to provide a significant advantage in terms of resistance to dropped object loading. Hence, both pipe materials will require a similar level of dropped object protection.

SSL can be stabilised on the seabed using concrete weight coating in conjunction with either trenching and burial, rock bolting or Flexmats.

Compared with similar rated butt welded steel pipe, the resources required to carry out the SSL jointing processes is drastically

reduced and the daily completion rate is expected to be much higher. Furthermore, final coating of the SSL joint is not required.

### Cost Savings

While the base material cost of the SSL pipe is about 20 - 30% higher than an equivalent FBE coated line pipe, the total installed cost should prove to be about the same through the efficiencies gained from more economic installation practices.

The real cost savings to be gained are from the reduced operating expenditure required to operate an SSL pipeline. These savings equate to:

- No requirement for chemical injection to protect the pipe;
- No requirement for cathodic protection;
- No requirement for use of intelligent pigs to inspect the pipe;
- Lower pumping costs due to the larger internal diameter and smoother bore;
- Minimal or no regular maintenance costs.

In addition, an SSL pipeline, unlike steel, can be easily retrieved after the effective end of a field's life, tested and reused at another location. This is a benefit so far unmatched by any onshore/offshore pipeline system on the market today.

### Acceptance sought

Ameron have successfully taken SSL from concept to production in a relatively short period. The hard work only now begins, however, with the attempt to gain market acceptance for the product.

Negotiations between Ameron and three major operators in West Africa, South America and Eastern Europe are currently being finalised for sizeable hydrocarbon pipelines.

SSL has much to offer local operators, especially in the Carnarvon basin where corrosion problems caused by the presence of CO<sub>2</sub> and/or sulphur reducing bacteria have reeked havoc on returns from marginal fields.

SSL offers a way for the operator to reduce and stabilise their operating costs, which is a substantial crux, particularly with the volatile crude prices that promise to be with us for sometime. **AOGN**