

# Composite flexibles rule in deepwater fields

20% lower total  
installed cost

vs. conventional flexibles

30% lighter  
weight

vs. conventional flexibles

Enabling 15 Ksi

beyond 3,000 m

150 °C  
capability



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GE\_SS\_CompositeFlexibles-042516



GE Oil & Gas

# Driving cost efficiency in deeper water

Next-generation flexible pipe



# Increased productivity in deeper waters

Low oil prices, along with cost and schedule challenges continue to weigh on the oil and gas sector globally, providing some of the most difficult challenges in the industry's history. Meanwhile, global offshore reserves are also shifting to more remote locations that offer extremely complex and demanding conditions.

Vital new opportunities exist in deeper waters, most notably in the Gulf of Mexico and West Africa, but technological limitations can impede or block progress.

Flexible risers provide enabling benefits in this area, increasing subsea-layout versatility, enabling the use of floating production units, and handling dynamic conditions. But, as operators need greater cost efficiencies, conventional designs are still limited when it comes to moving into deeper waters.

GE's new composite flexible pipe changes that.

## Composite flexible pipe

Conventional flexible pipe contains multiple layers that perform separate loadbearing functions, and conventional designs may be heavier than rigid steel pipe, which is homogeneous and can be more efficient in carrying load. The additional weight of conventional flexibles impacts not only the raw material usage, but also the transportation, installation, and the infrastructure needed to hold them in place.

Composite flexible pipe solves this problem by replacing the metallic pressure armor layer with an innovative composite bonded liner. This game-changing design combines all the recognized system benefits of the flexible solution with a lightweight structure ideal for deepwater field access.

The new composite bonded liner makes the pipe 30% lighter than conventional flexibles, and increases value throughout the entire supply chain. More pipe can be stored and transported per reel and, critically, field configurations can be significantly streamlined by reducing or eliminating the need for costly supporting ancillaries such as buoyancy, clamps and tethers.

## Taking it further

We are also delivering the industry's first 15 Ksi capability for flexible transfer lines, jumpers, risers and flowlines.

Offshore operators now have a cost-effective and reliable way to improve their reach into deeper waters and more challenging environments.

The enabling technology is an innovative high-pressure, high-temperature barrier made from a new grade of copolymer. This is suitable for both conventional and composite flexible solutions.

### Key advantages:

- Does not suffer from microcracking at high pressures
- Contains no plasticizer, so there's no risk of shrinkage
- No need for impact modifier additives, because its ductile brittle transition is lower than -40 °C
- Combines excellent chemical resistance and stability up to 150 °C with excellent fatigue performance

# A long history in deep sea

GE's portfolio of flexible pipeline solutions draws on over 30 years of research and development, material science, and innovation. Our flexibles are installed in some of the most extreme conditions across all major oil producing regions, including the Gulf of Mexico, Asia Pacific, Middle East and Sub Saharan Africa.

We take a comprehensive approach to flexible pipe solutions – providing custom design and manufacturing as well as expert installation and integrity management services to ensure optimized safety, efficiency and productivity over the full life of the field.

With two Innovation Centers specializing in flexible pipe, and the unique shared knowledge and resources of the entire GE Store, we are committed to investing in technology. And we're continually evolving – not only designing solutions for today's challenges, but also pushing technological boundaries and driving long-term durability and success for the more extreme challenges yet to come.

### GE's global resources for flexible pipe solutions:

- 2 major manufacturing facilities in the UK and Brazil
- 1,500 employees worldwide
- 7 dedicated regional support teams worldwide
- 570 nkm\* annual production capacity
- 3,500 nkm manufactured to date
- 2-19 inch internal diameter product range
- 3,000 m water depth capability
- 15,000 psi pressure capability

\* normalized km of 8-inch ID pipe

Quality is defined by our customers. As they move into deeper water and more remote locations, they rely on our pipes to withstand extreme temperatures, pressures, physical stresses, and increasingly corrosive environments. Everything we design, engineer and manufacture is customized to meet the specific requirements of each project – tested to the highest standards and meeting all applicable regulations.

GE Oil & Gas is at the forefront of developing standards and practices for the incorporation of carbon-fiber thermoplastic composites into flexible pipe. We've augmented our extensive internal research and installed experience with industry-wide collaborations, including certification agencies such as DNV GL, and joint industry projects such as the RPSEA program "Qualification of Flexible Fiber-Reinforced Pipe for 10,000-foot Water Depths."

Design tools have been developed and validated step by step through extensive material characterization, sub-component and component testing, and full-scale testing. The qualification program will continue throughout 2016 with a full-scale dynamic bending fatigue test of a 10-inch riser.

A new composite manufacturing module at our Newcastle manufacturing facility will be fully operational in 2017, with a range of composite pipe sizes scheduled for qualification and completion in 2018.

Images: burst test (top), static bend test rig (bottom)

### CONVENTIONAL

### NEW COMPOSITE PIPE

