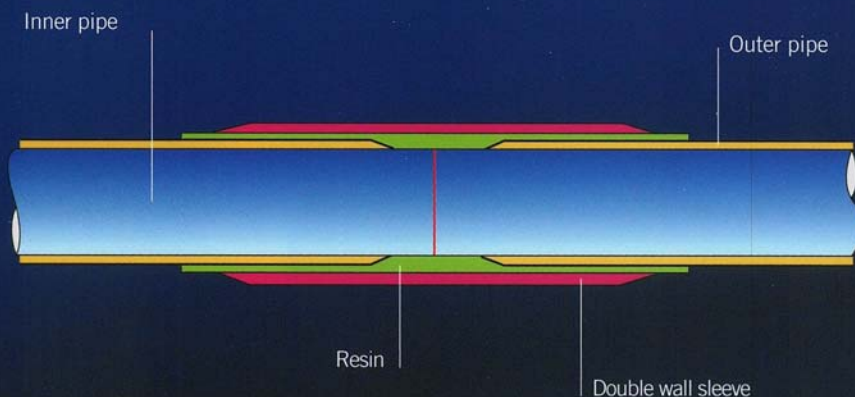


## HIGHLY INSULATED PRODUCTION FLOWLINES

The subsea network that carries Rosa crude consists of 64 kilometers of production flowlines insulated using ITP's Pipe in Pipe technology. Each line consists of two concentric tubes. Izoflex™, an insulating material, is inserted in the annulus and a vacuum (air at 10 mbar<sub>a</sub>) is created. Swaged joints (pressure-formed joints) are used to assemble the pipe sections.



## RISER TOWER: INNOVATIVE DESIGN

The new concept (BHOR) implemented for the riser anchored to the west of the Girassol FPSO is another major innovation of the Rosa Project, combining highly effective thermal insulation and buoyancy. The 1,200-meter-tall structure comprises four production risers (8" x 17") of Pipe in Pipe technology, along with two water injection risers (10") and four gas lift lines associated with the 8" production flowlines. The entire assembly is wrapped in syntactic foam which holds it together around a central steel tendon (18") and contributes to the structure's buoyancy. The riser tower is stabilized in vertical position thanks to the syntactic foam components and a steel buoyancy tank 6 meters in diameter and 35 meters high.