

FMC SOFEC Very Large Turret

Floating production specialist FMC SOFEC has just completed development of a new type of turret design that could more than double the number of riser pipes able to be handled by a turret-moored vessel. It is billed as suitable for water depths between 500 and 3000m and for fields producing 100-250 kbd.

The turret is of course effectively the spinal cord of a ship-shaped FPU, handling everything that has to be transferred up or down between seabed and sea surface – oil production, injection water, lift gas, chemicals, electrical power, and control signals for subsea wells - as well as being the focal point for the vessel's pattern of mooring lines.

At present the largest number of risers for turret-moored FPSOs are 45 and 47 achieved by two units off Brazil: on Espadarte and on P35 in the Campos Basin.. That is widely regarded as being close to the upper limit of what can be accommodated in the compact, small-diameter design of internal turrets so far evolved by the select group of three or four companies who dominate this field.

Now FMC SOFEC has come up with the “very large turret” (VLT) concept which the Houston company says “provides a cost-effective system for 100 risers or more”. To date it has only been possible to handle that many risers by connecting them to porches along the outsides of a spread-moored FPSO that cannot weathervane into the prevailing weather.

In benign environments such as off West Africa and to a large extent also Brazil, this has not been a problem. Big world-beating FPSOs like Girassol, Bonga and Kizomba A off Africa, or the Albacora Leste and upcoming Barracuda and Caratinga units off Brazil, all take the spread-moored approach. They are able to do so because there is a single direction for prevailing weather that the production vessel can be pointed into and held by a fixed pattern of mooring lines.

However, turret mooring is undoubtedly a more elegant solution, and is also so far the only one possible where weather is anything other than benign and uni-directional. In this case the vessel can happily weathervane around an internal turret - punched through the hull somewhere in its forward half - that is essentially an extension of the stationary seabed. Also direct tandem offloading to shuttle tankers is a more assured and less risky business than with a spread-moored FPSO, where a separate remote offloading buoy some distance away is often adopted at considerable additional expense.

However, significant loads have to be transmitted from a turret to the ship's hull as it does its job of providing the link to mooring lines and carrying the weight of the deepwater riser pipes hanging off it. To keep on top of the problem of providing bearing systems that can swivel while at the same time supporting such loads (maybe 5000 tonnes or more) turret bearings have so far been limited to about twelve metres in diameter.

This in turn means that there is not a lot of room down the inside of the turret in which to fit all the necessary riser pipes and other associated hardware. With the VLT,

FMC SOFEC has broken free of that constraint, boosting turret diameters to anything from 20 to 40 metres, in which latter case it could accommodate up to 120 risers.

“While the traditional segmented three-row roller arrangement provides high bearing capacity in a small package, it also calls for extremely tight fabrication tolerances and cannot be taken much above 12 metres diameter,” says FMC SOFEC project engineering manager Chuck Garnero.

“So we have designed the top of our new turret in the form of a large spoked wheel with an AmClyde-type wheel and rail bearing at its perimeter, similar to that used for offshore heavy lift cranes,” he continues. “This can carry twice the (16,500 tonne) load exerted by the largest VLT in 1300m of water and is able to serve for applications all the way down to 3000m.”

Such a system is far less sensitive to the hogging and sagging of the vessel’s hull as it moves in the water. “The turret top is somewhat like a pancake,” says Garnero. “It is a flat compliant surface that flexes with hull movements in extreme conditions.” He emphasises that this flexing is relatively small: “It might deflect a maximum of 30 mm at the centre of a 40m diameter turret,” he points out.

A further benefit of the VLT is its large top area. All the pipework trickery that is needed on the geostationary “seabed” part of the assembly can be performed at a single level, before oil is transferred on to the weathervaning vessel via a stack of fluid swivels.

Until now this piping and manifolding has been forced to spread out upwards over several smaller levels, calling for expensive compact designs. “Instead of building up, you can build out,” says Garnero. He and three of his colleagues are due to give a detailed paper on the whole system at this year’s OTC show in May.

Clearly, a large diameter turret calls for a large diameter hole in the vessel, but this does not present any unsurmountable problems in maintaining hull strength. “You have to put back the same amount of steel into the remaining part of the hull as you have taken out for the moonpool,” stresses Garnero.

He points out that when FMC SOFEC installed a turret for the 50 kdwt FPSO P34 now stationed on Brazil’s Barracuda field, over two-thirds of the vessel’s beam was taken up by that turret. “A VLT for 90 risers should take up no more than half the beam of a ULCC,” he says. “With this new design, you are no longer driven to a spread-moored solution if you have lots of risers. The turret has become an option.”