PIGGING MULTI-DIAMETER PIPELINES – AN ENGINEERED SOLUTION

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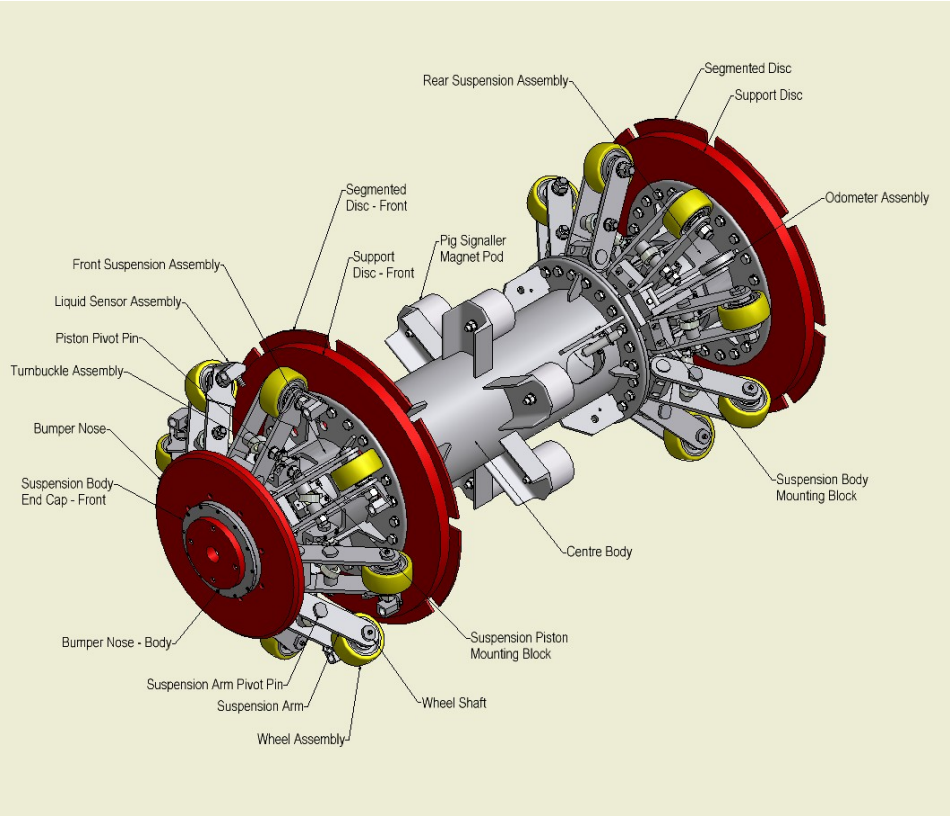
CMSS
THE BENEFITS OF A TRUE MULTIDIAMETER SUSPENSION SYSTEM.



Introduction

The centreline multidimensional suspension system (CMSS) was designed and patented by FTL Seals Technology Ltd (FTL) as a direct result of the pipeline pig functional requirements for the Statoil Åsgard pipeline RFO commissioning project in 1998.

Customer problems were reduced to a set of functional requirements and through attention to detail monitored via an ISO 9001:2001 Quality Management system a solution to the particular problem is reached.

In the instance of the CMSS it was resolved early on in the design procedure that a new and revolutionary approach had to be adopted if the functional requirements were to be met whilst at the same time upholding the philosophy of FTL.

The majority of previously designed commissioning pigs adhered to well established design concepts in that all functions of the pig could be met with a relatively simple low cost design. The Åsgard multi diameter gas transporter line however was totally different.
The pipeline length would be 710 km at 42" diameter and the last 500 metres would reduce to 28" diameter. Drive disc and support disc wear would be a critical consideration.

By applying basic hydraulic cylinder design principals FTL decided that contrary to previous designs the support function of the pig should be completely separate from the sealing and drive function. Due to the expected high rate of wear that the sealing discs would have to withstand it

was decided to take the hitherto unprecedented step for a commissioning pig to mount the whole unit on a self supporting and self centering suspension system.

By careful design and incorporating variable suspension geometry the potential to overload the wheel assemblies was avoided when passing from the larger to the smaller diameter pipeline sections. Furthermore, a slow controlled rotary motion would be imparted to the whole pig train to even out the wear on the discs.

High efficiency pigging.

In repeated testing it was found that CMSS suspension will run within 0.2% of pipe centre line (1.0-2.0mm in a 42 inch flow line).

This means that a major benefit of CMSS is that a high degree of pigging efficiency can be achieved making it particularly suitable for ready for operations (RFO) work including MEG swabbing.

In the Åsgard swabbing run six pigs were launched with glycol slugs between the first four pigs, and dry air between the last pigs. This was to pick up the remaining glycol and water in the line from pipe components such as tees.

At the end of the run, the three glycol slugs were sampled and the percentage water content measured to indicate the efficiency of the operation. It was found that only 0.4% water in glycol was recorded in the last liquid slug, compared with 3% to 4% from previous dewatering. This was the most efficient Glycol Dewatering ever recorded by the operator.

By offsetting the longitudinal axis of the suspension arms by a small amount the pig assembly is encouraged to rotate.
This gives two benefits:

1) the drive disks are worn evenly
2) each wheel experiences an interval of minimal load when passing top dead centre, hence prolonging the life of the wheel/bearing assemblies.

Low delta P drive pressure.

The ability of CMSS to run on centreline gives a benefit to the pig manufacturer and the operator in that the traditional oversize on the outer diameter of the drive discs, to compensate for the wear in long dry gas pipeline runs, is now minimized and allows drive disc design to be optimized.

As there is less material in contact with the pipeline wall during the pigs journey the friction generated between drive disc and pipe wall is now much reduced.

Tests conducted at Statoil's "K lab" show that a drive pressure differential of approximately 0, 2 bar is sufficient to move the unit smoothly along the pipe.

The reduction in delta P drive pressure also allows the design of the drive disc to be optimized with respect to the "flip over" pressure.

Traversing vertical "Y" pieces

Because all suspension arms of CMSS are interconnected, the suspension can maintain its pipe diameter geometry with only two arms in contact with the pipe wall.

This feature offers an additional benefit to operators in that should off takes not be fully barred then the is little fear of loosing a wheel and suspension arm as is the case on some independently sprung systems where the suspension arms are fully independent of each other.
A development CMSS vehicle was built following successful trials for pulling a MFL inspection tool through a vertical dual diameter pipeline feature expanding from 16" to 20".

Progressive cleaning

The benefit that CMSS systems can guarantee at or near centreline running was recently exploited by a pipeline operator who was unsure what was in the line causing flow losses.

A programme of progressive cleaning was agreed by gradually increasing the interference between pipe wall and cleaning disk. However as the condition of the pipe was unknown (it was feared that there may have been a very high build up of debris) it was important that the cleaning/gauging pig remained in the centre of the line.

Although the pig was designed to run in a fixed diameter pipeline of a nominal 36inch diameter the operators were not certain about the mechanical condition of the pipe. Should the pig encounter any pipeline defects along its journey then the self centring suspension system would be able to cope with the pipeline geometry.

Stable camera platform

Pipeline tools fitted with CMSS offer a high degree of repeatability with regard to running on centre.

This performance is even maintained when negotiating pipeline features such as small diameter bends.

"Nose Diving", due to the weight of the pig when running horizontally can be a problem in long dry pipeline runs. The force generated by the suspension system is such that it is greater than the weight of the pig unit. By fitting a pair of CMSS modules a stable horizontal platform can be obtained.

This benefit is used in an optical inspection tool, fitted with CMSS modules, ensuring that the tool remains at or near the true geometric centreline of the pipe throughout its run.