NO ONE WANTS A PIG IN A POKE

Various methods of pig tracking have been developed over the years as the methods of pipeline cleaning and maintenance have developed from a closely guarded black art into an ever-improving science. Devotees have long-since laughed at the old story concerning the origins of the cleaning tools terminology or 'pigs' – as they squeal and rumble like a pig as they pass – but this is one of the oldest and most reliable detection methods.

In simple terms the tracking devices attached to the cleaning tools for the purposes of tracking use acoustics, electromagnetic, rare earth high strength magnets or radioactive sources. Like all tools, in order to ensure that they perform as required, they need to be correctly designed, manufactured and applied. In other words, serious consideration needs to be applied to the functionality of the tool. Basic design parameters

There are numerous considerations that need to be made when applying pig tracking systems; the last thing one needs is a failure due to inaccurate information. **Simon Bell, iNPIPE PRODUCTS, UK,** highlights some reliable pipeline pig tracking methods that achieve quality results.

include the design and materials of construction of the cleaning tool carrying the transmitter, the materials of construction and features of the pipeline, the complexity of surrounding geography, the medium of pigging, and finally the length of the pipeline itself. The most frequent cause of pig tracking failure is often the result of inaccurate information being provided to the pig tracking supplier.

In addition to pig tracking devices, it is also possible to calculate the theoretical position of the pig by calculating the flowrate through the pipeline and time. However, such calculations need to consider whether the medium is liquid or gas and to what degree the output of the pump or compressor can be guaranteed. Such accurate flow characteristics also rely upon the assumption that there is no bypass over the pig, which is often not the case where pigs enter pipeline features such as bends, tees, or weld beads for example. Clearly the actual variation, compared with the theoretical assumptions, can increase in direct proportion to the distance travelled; 1% variance on a 330 km pipeline relates to searching 3.3 km for a stuck pig.

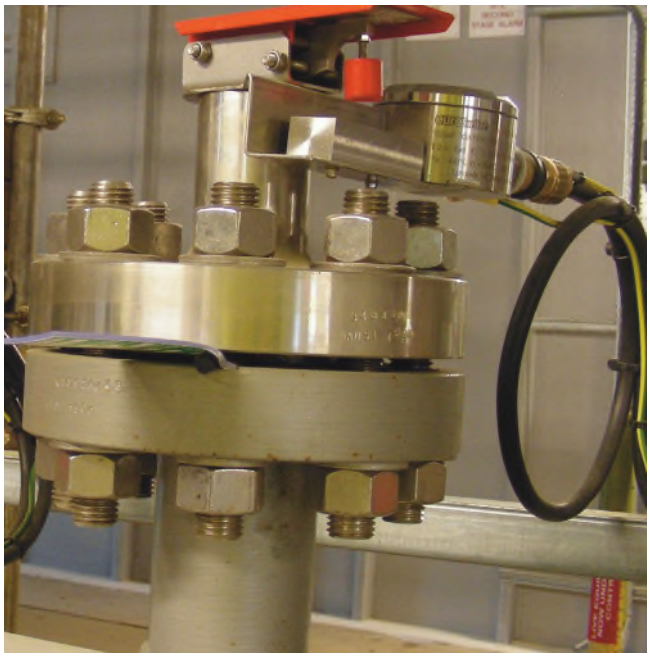

Figure 1. Intrusive pig signallers.

Fixed point intrusive pig signallers

Intrusive pig signallers have traditionally been mounted on to pig launchers, receivers and pipeline systems to advise when the pig has passed a specific point. Design considerations include correct material mating with the pipeline materials of construction, the ability to be removed under pressure and the correct trigger length to ensure that the pig seals/cups trigger the signal. The innovative iNPIPE PRODUCTS™ pig signaller is designed to operate and trigger through 360°, which provides quick installation and cannot be installed with the wrong orientation – a common problem with uni-directional pig signallers. Intrusive signallers can also be provided for connection to SCADA systems or even with remote telecommunication so that the pig passage can be relayed directly to mobile phones.

The benefit of the mechanical intrusive pig signaller is that it requires nothing more than the physical passage of the cleaning tool to trigger the device, though obviously there are whole range of add-on features, including extensions of up to 2.5 m for buried pipelines. Correctly designed, installed and maintained, these units have proven they provide decades of failsafe performances around the world and subsea applications that are still working today.

Fixed point non-intrusive pig signallers

Non-intrusive pig signallers for the detection of acoustic or electromagnetic transmitters fitted to the cleaning tools have been developed over the last 30 years. Their performance relies upon the detection of either an electromagnetic field or an acoustic ping and consequently battery life and size is one of the most crucial considerations. Over recent years battery technology has rapidly improved so transmitters are gradually becoming smaller and more reliable; additional technologies, such as pressure activation switches have enabled transmitters to remain dormant for many months until they are energised by

Figure 2. Typical examples of 6 in. cleaning and gauging pigs designed to incorporate four methods of pig tracking/location – neodymium iron boron magnet bracelets, an electromagnetic transmitter, acoustic pinger, radioactive isotope, and smart gauge data logger. The innovative source container is an integral part of the patented wet-buckle insertion tooling design developed for the Ichthys project in Australia.

an increase in pressures as the cleaning tool is launched. This conserves the battery power until it is needed when the pig is moving.

Externally mounted, handheld or ROV operated detection units can then be used to detect the cleaning tool/pig as it passes by means of the acoustic ping or the magnetic field generated. In addition to battery powered electro-transmitters, rare earth neodymium iron boron magnets can be mounted in a bracelet arrangement or within the spacer discs on smaller pigs, depending on the cleaning tool and bend radius size, which can also be detected non-intrusively. Orientation of the magnet arrangement requires careful consideration to ensure optimum performance.

The tracking benefits of acoustic pingers in the field are strong. Their range can be several kilometres and tracking is possible to within a few metres with the use of directional headphones and an ROV or diver in shallow water. Different frequencies can also allow for the individual identification of every cleaning tool within a train of tools so it is possible to gain a better insight inside the pipeline. The acoustic pinger has to be in water in order to transmit a signal and the pipeline must be surrounded by water for the signal to be detected by the hydrophone. Complex pipe in pipe constructions, pipe coatings and burials also decrease effectiveness and accuracy of signal. Solid obstacles, such as offshore platforms, sea-bottom outcrops, and layers of water with differing temperatures can all reflect and corrupt the pinger energy signal.

Radioactive isotope pig tracking systems have been developed and have proved extremely effective, relying on a small radioactive source attached to the pig. The radioactive source is again tailored to the size of the pipeline, wall thickness or pipe in pipe arrangement with project specific source duration of up to two years on some applications. The project specific tailoring enables the level of radiation to be kept to the absolute minimum to minimise the potential hazard to divers and launching technicians. Externally mounted, handheld or ROV operated detection units can then be used to detect the cleaning tool as it passes by means of the isotope source. Specialised technical support and transportation is required with transportation containers necessary for mobilisation and disposal.

Design considerations for tracking method selection

It is evident from the preceding information that effective pig tracking or potential location is an important consideration. Designers should consider the relevant features of the pipeline, medium and potential power requirement based on the pipe length and duration of pigging; for example, certain subsea installations may need to remain in place for some months before operation.

Pigging regimes can change throughout the lifecycle of a pipeline so pig tracking and pig location should be considered independently. Pig tracking is best used as part of the ongoing pipe cleaning, gauging and inspection processes. Non-intrusive systems are often used as part of a periodic but temporary tracking, and have the benefit of installation and removal of the monitors to the pipelines without production interruption. Unfortunately, this installation method can occasionally lead to easy theft in remote areas of the world. The flexibility of the system can also lead to misuse when the transmitters, receivers and signal corruption by the pipeline features, wall thicknesses and locations are not correctly considered.

Figure 3. Bespoke Ichthys project pig test loops.

Design considerations for pig/cleaning tool design

The method of pig location signal to the receiver basically depends on the size and location of the transmitter carried by the pig; the battery powered acoustic or electromagnetic transmitter, radioactive isotope or the neodymium iron boron magnets. In simple terms, it is desirable to have the largest power source (battery) available, which is generally fine in larger pig bodies, but the smaller the diameter the more difficult it is to fit everything in. Similarly, the complexity and location of bends and other features can often impact upon the length of the pig body and again constrain the size of battery and consequent transmitter.

Conclusion

To ensure that intrusive signallers, non-intrusive magnetic or ultrasonic signallers, acoustic pingers and electromagnetic transmitters work correctly it is most important that all the pipeline data is provided to the supplier of the pig tracking equipment. Pig body material, pipewall material and wall thickness, water depth, burial depth, pipeline length, flowrates, and products being transported are all things that can affect the reliability of the pig tracking method being used. Most of the equipment is simple to use and with very little training most people are able to operate it to good effect. However, if the equipment is abused and poorly maintained then it may not perform as expected.

There is a system to suit most applications, be they for permanent or temporary installation or for subsea or above ground applications, and pipe within pipe requirements. All of the systems are reliable if treated and deployed correctly and most importantly properly maintained. Best results will be achieved if personnel using the equipment are properly trained in its use.