



## **EMERGING ISSUES OF THE NEXT 10-20 YEARS**

By Nathan Stephenson, Pipeline Engineer, Shell UK Limited

The assurance of pipeline integrity has always been important. However, the industry and society expectations have combined to place ever increasing demand on operators, with respect to HS&E, financial and reputation issues. Against this background and with an ageing North Sea pipeline infrastructure it is necessary that we address all the key aspects of pipeline integrity management, such as; correct operation, corrosion management, flow assurance and inspection. The programme for this session reflects all of these key areas.

This paper will focus on some emerging issues relating to pipeline pigging operations in three specific areas; pigging pipelines under low flow conditions, pigging pipelines to control/mitigate MIC corrosion and new technology opportunities.

### **1. Pigging pipelines under low flow conditions**

#### **Chemical cleaning for In-Line-Inspection (ILI)**

In the times of ageing pipeline infrastructure, the need to guarantee pipeline integrity is becoming ever more important. The only reliable method for accurately inspecting a pipeline from pig trap to pig trap is to run an intelligent pig. Intelligent pigging is therefore one of the key tools used as part of pipeline integrity management.

In declining fields with lower flowrates the issue of pre-conditioning (cleaning) pipelines for an intelligent pig run, especially in waxy crude oil pipelines, is becoming ever more difficult. Historically, when flow rates were higher and pig runs times were lower, the conventional method for cleaning pipelines for an intelligent pig run was to run series of aggressive cleaning pigs. The decision to run the inspection tool was then taken once the wax returns drop off. Due to low flowrates in large pipelines wax can often be laying down in between pig runs. In some circumstances the lack of mechanical scraping effect of the pigs, due to the low flow conditions, can prove difficult to strip the hard wax deposits from the pipe wall, regardless of pig type.

With production in decline, there is an increasing requirement to use chemicals to clean pipelines prior to carrying out an intelligent pig run. The PPSA could support operators by expanding the Buyers Guide & Directory of Members to include suppliers of wax inhibitors to further promote their use and application. Obtaining case histories from other operators on the successful application of wax suppressing chemicals to clean oil lines for in-line-inspection would be very useful. This would be a very relevant subject for the 2005 PPSA seminars.

#### **In-Line-Inspection**

Having sufficiently cleaned your large waxy crude oil pipeline under low flow conditions, then comes the next challenge: providing enough flow to satisfy the low velocity cut off point of MFL inspection tools, typically quoted as being 0.3-0.5m/s. Spilling gross fluids into the pipeline, or providing a dedicated pumping unit to introduce more flow, is the usual way to overcome this problem. Each method has unwanted costs and operational difficulties associated with it.

The development of an ultra-low velocity MFL intelligent pig, able to operate at speeds  $>0.1\text{m/s}$  would be hugely beneficial to pipeline operators. A tool capable of inspecting pipelines at ultra low velocities would be extremely marketable under current conditions and would become even more so in next decade or two as production is set to decline further. The pipeline inspection industry and

pipeline operators should be working together to overcome the challenges associated with the development of an ultra low velocity MFL intelligent pig.

## **Pigging Operations**

Pipeline pigging operations under low flow conditions require close attention, as this can often result in a problematic launch or receipt of a pig, resulting in time consuming additional work for operations personnel.

Pigging procedures that were written many years ago may need revising to suit the new operating regime. Specifying definitive timescales for routine flow through pig launchers and receivers, ensuring full flow through pig traps, maintaining operability of intrusive pig signallers or attaching non-intrusive pig signallers, are all things which can add confidence when pigging pipelines under low flow conditions. Many of these steps can be integrated into operating procedures to ensure a consistent approach is taken time after time.

## **2. Pigging pipelines to control/mitigate MIC corrosion**

The threat of Microbiologically Influenced Corrosion (MIC) is something, which has surfaced as a concern to pipeline operators over the last few years. MIC corrosion is becoming more of an issue for older fields where reservoir pressure is being supported by water injection. Mitigation methods usually involve periodic biocide treatments of the pipeline.

There may be some benefit in trying to control the threat of MIC corrosion in production pipelines by running specifically designed cleaning pigs on a routine basis at set frequencies. There is a development opportunity to design a type of cleaning pig, which targets or restricts the build up of bacteria in pipelines. If deemed worthwhile this would give the pipeline operator some reassurance to either reduce or extend periods between biocide treatments.

## **3. New Technologies to tackle the challenges ahead**

### **Inspecting subsea flowlines with limited pigging facilities**

With more and more production coming from subsea wells (Shell UK has over 60% of its total production delivered from subsea tie backs consisting in nearly 130 subsea wells) tied back to existing infrastructure, focus in future years will be on assuring the integrity of the subsea facilities and performing in-line-inspections of subsea flowlines. In the many cases full pigging facilities are not always installed to reduce project CAPEX. In these cases remedial works are needed to make the system 'piggable' by installing temporary pig launchers / receivers or connecting subsea pig receivers. When tying additional components oil deferment, is usually incurred. Likewise when pigging subsea flowlines, as flow is routed in the opposite direction to the normal product flow in order to drive the pigs through the subsea system.

There is a definite need for new technologies to perform in-line-inspection of subsea flowlines, which can be deployed with limited pigging facilities and limited oil deferment. There has been some new technology entering the marketplace such as Bi-Di MFL for pump-in pump-out purposes and the development of the Crawler pig for use in reverse flow application. These concepts were developed so that the pipeline operator has limited cost exposure when running pigs in subsea flowlines. Configuring the subsea system to be 'piggable' in the conventional manner is often very expensive. Continued focus is required to develop tools and systems in order to overcome the challenges associated with performing ILI of subsea flowlines.

## **Flow assurance / Data Loggers to cater cleaning programmes for In-Line-Inspection (ILI)**

Pigging programmes to clean pipelines for ILI are often developed by pipeline engineers and consultants; drawing on years of experience and taking the operational history of the pipeline into account. The pigging programmes are usually an iterative process and generally evolve as the pig trash returns are assessed after each pig run. In difficult to clean pipelines this tends to result in a longer cleaning time with the procurement of several types of pigs.

Rather than go through the trial and error phase of enhanced pipeline cleaning, it would seem logical to try and gather enough intelligence about the condition of the pipeline to cater the cleaning programme (pig types, frequency, chemicals etc) to suit the condition of the pipeline. This would mean an initial cost outlay, but on difficult to clean pipelines this would almost certainly be paid back, by timesavings due to clearer focus on the enhanced cleaning strategy. Data gathering exercises could involve some form of hydraulic analysis of the pipeline, in order to try and predict the amount of debris in the pipeline prior to starting the enhanced cleaning exercise. In addition to the flow assurance analysis the use of data logging pigs, measuring differential pressure, vibration, temperature can also be used to gain further information on the condition of the pipeline. Such approaches have not been fully developed and packaged as a marketable service but this could be an area for expansion.

## **Low cost alternatives to Intelligent Pigging**

Performing an intelligent pig run is a high cost activity and something that pipeline operators would like to optimise. Circumstances such as pipeline age, pipeline operating conditions and integrity assessments dictate the inspection intervals and in most cases operators are left with little choice other than to run an intelligent pig to fully inspect the pipeline.

Low cost alternatives to intelligent pigging are not something new, yet this area has yet to be fully explored. The market is there for semi-intelligent or smart utility pigs. In future years as reserves decline there will be a continued drive to reduce operating expenditure and ultimately pipeline inspection costs, without compromising integrity. The limitations of the smart utility pigs need to be understood by pipeline operators, so their application can be targeted to address specific areas and add more confidence to pipeline integrity assessments. Pipeline integrity reporting with good quality inspection data will increase confidence, and extend the inspection intervals therefore reducing the total cost ownership of operating pipelines.