

PIG TRACKING – FOLLOWING THE PROCESS

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Abstract

Inline inspection campaigns can cost many hundreds of thousands of pounds to perform, whilst an unsuccessful pig run can cost an Operator significantly more. This is especially true for subsea pipelines where access is restricted, and remediation is complex. In order to help reduce this risk, many Operators choose to use pig tracking systems as a standard service for any pig run.

Tracerco's proven pig tracking system has recently been instrumental in a successful dewatering and conditioning campaign on a complex pipeline system. The pipeline was new and included several valves which had the potential to impede the safe passage of the pigs. By using Tracerco's pig tracking system, the Operator was able to accurately monitor the passage of pigs through the pipeline and accurately locate a stalled pig.

Introduction

Pipelines are often referred to as “arteries”, transporting the oil and gas necessary to the modern lifestyle around the world and, in a similar way to normal arteries, they too can become affected by narrowing and blockages. Current estimates are that there are in excess of 2 million kilometres of pipelines in operation worldwide, each of which will have a different susceptibility to blockage, depending on operational conditions. Pigging operations are performed routinely on these pipelines for the purpose of cleaning, inspection and (in some cases) batch separation of products. Types of pigs range from simple foam or mandrel pigs for pipeline cleaning, to complex intelligent pigs designed to determine the overall integrity and condition of a pipeline. Plugging pigs are also used; these are pigs which have been designed to isolate a pipeline section whilst repair work is undertaken. As these are intrusive techniques a stalled, mispositioned or even lost pig can cause significant disruption to normal pipeline operations and may also present a safety risk.

Project Background

Tracerco was requested by a GOM operator to supply pig tracking radioisotopes and equipment for use on the dewatering, conditioning and commissioning phases of a newly installed pipeline which was over 200 miles in length.

Tracerco GammaTrac™ and ROV alarm equipment was allocated for the project to track the pig launch/receipt times. The Tracerco ROV Alarm equipment consisted of a subsea radiation detector that is integrated through the ROV, to provide results in real-time to a topside laptop computer. Two Tracerco engineers and the full equipment spread were mobilised and deployed to three marine support vessels (MSVs). Radioisotopes were loaded into the initial three pigs for the dewatering phase and introduced into the pipeline.

The pipeline system included several isolation valves which had the potential to restrict the passage of the pigs through the pipeline. As such, the Operator employed a suitable tracking system as part of the pigging campaign.

Conventional pig tracking systems require a power supply which means the available tracking time is limited by the battery life of the system. To some extent, battery life is dependent on the available space on the pig and in some cases, the battery life can be as low as 50 hours after which, the pig becomes undetectable. The calculated run time for this project was 14 days so the operator selected radioisotope pig tracking as the most reliable method. Tracerco’s radioisotope-based system is not constrained by a power supply and can provide unlimited tracking time with a locational accuracy to within 5cm. In addition, it is fully adaptable for use with all pig types including in-line inspection tools as it simply “tags” the pig with a small, purpose-designed radioisotope which fits into the standard tool housing.

Radioisotope Pig Tracking

The tagged pig can be tracked or located using Tracerco's GammaTrac™ instrument. The instrument contains a highly sensitive radiation detector which detects the tagged pig through the pipe wall.



The unit can be operated in several different modes:

- Flagger - On detecting a labelled pig, a red light is illuminated and remains illuminated until the unit is reset
- Totalizer - Counts the total number of labelled pigs that have passed down the line. This is displayed in numerical form up to a total of 99
- Interrogator - Determines the detection of the pig or pigs to "real time". The display consists of both a numerical counter indicating the number of pigs that have passed the particular location and a time display that displays the time at which the last pig passed the unit, accurate to 0.01 seconds
- Ranger - Gives an analogue display according to the proximity of a labelled pig. It enables the position of a stationary pig to be determined accurately; usually to within + or - 5 cm

Both subsea and ATEX versions of the GammaTrac™ are available.

Pre-Project Planning

For Tracerco, the first step for the pig tracking campaign was to determine the most appropriate radioisotopes to use. In this instance, the radioisotope size selection was based upon the main parameters of the pipeline (material, wall thickness etc); where multiple wall thicknesses or materials are used, the radioisotope size will typically be calculated based on the most prevalent pipeline parameters. Tailoring the radioisotope size (activity) to the project in this manner ensured that the levels of radiation at the outside of the pipeline were kept as low as reasonably practicable.

The intensity of the radiation signal emitted from the source is dependent on several factors:

- The radionuclide
- The activity of the radioisotope
- The distance from the radioisotope
- The thickness of the material between the radioisotope and detector
- The density of the material between the radioisotope and detector.

The optimum radioisotope size is then calculated using the pipeline diameter (the distance from the radioisotope), the wall thickness and density of the pipeline fluid.

The radionuclide has a gamma-ray energy high enough to penetrate the steel pipeline walls and a relatively short half-life of less than 120 days. The half-life is important in the event that a tagged pig cannot be recovered as the radioisotope will decay to background levels in a relatively short time. It is therefore important to understand when the pigging project is likely to be completed and calculate the optimum activity at the recovery stage.

All source handling is performed by Tracerco technicians who are trained and qualified as Radiation Protection Supervisors under the Ionising Radiations Regulations 2017.

Dewatering Project Phase One

During the project planning stage, the pipeline operator had planned to utilise 7 GammaTrac™ units strategically positioned immediately downstream of key pipeline features such as valves and ILS's. Prior to the Phase One pigging, this was revised to only 4 GammaTrac™ units.

The 3-pig train was launched and the pipeline differential pressure and discharge on the platform end were monitored. After some time, it became apparent from the pressure drop and water returns on the platform that there was an issue with the progress of the pig train. The ROV confirmed that the third pig had not reached the first subsea GammaTrac™ and a search was started using the ROV Alarm detector. The pig was eventually located approximately 75 miles away from where the operator had expected it to be. The search area, and hence the time taken to locate the pig, could have been significantly reduced had the operator deployed all 7 GammaTrac™ units as originally planned. The pig was damaged during the launch and had subsequently been bypassing. This situation was resolved after a regimen of pressure pulsing and pipeline bleed-off operations. A few additional GammaTracs™ placed upstream of the platform, which was originally planned, would have eliminated a significant amount of time and decreased project costs by following the pipeline subsea. The pigs were then tracked through the final 75 miles of pipeline utilising the ROV Alarm detector equipment to the parking location specified by the operator to complete the first phase of the dewatering operations.

Conditioning Project Phase Two

Phase 2 of the pigging operations began approximately a month later after the process piping was aligned and tested for the jumper tie-in to the platform. Another series of tagged pigs were introduced into the pipeline for tracking purposes. For this phase, twelve additional GammaTrac™ units were mobilised to be deployed subsea for the pig tracking operations. The monitoring positions for the units were placed at each of the 6 In-Line Skids (ILS) and In-Line Valves (ILV). With this amount of equipment deployed subsea, the pipeline monitoring coverage was divided into twenty sections which enabled the ROV equipped vessels to track the progression of the pigs through the pipeline during the conditioning

phase. The amount of subsea equipment utilised subsea initiated an effective tracking campaign for this phase of the project.

A total of 7 pigs were tagged and introduced into the pipeline. The MSVs utilised the Tracerco ROV Alarm equipment to track the pigs down the length of the pipeline. Utilising the Interrogator function, the total number of pigs were counted, and their time of passage was logged for each of the 7 pigs passing through all of the monitoring locations. The calculated pigging time for this phase was soon adjusted after the pig velocities were shown to be travelling slower than expected due to the change in bathymetry of the sea floor, displacement of sea water, the pipeline conditioning chemicals and nitrogen. The positioning of the GammaTrac™ units allowed operations to stay immediately up to date with accurate time stamps for each pig at each location. The pig passage times were relayed throughout the customer operations team in order to modify pumping rates and the chemical injection process.

The primary tracking vessel continued to follow the pig train down the length of the pipeline to the termination platform where the Tracerco technicians removed the radioisotopes during the pig recovery operations. A secondary vessel was utilized to recover the GammaTrac™ array and perform the necessary valve alignments for the pipeline shut-in procedure. The GammaTrac and ROV Alarm equipment utilised on this final phase ensured a timely completion of the project. In turn, the operator saved significant capital on vessel rental and was able to maintain the production start-up date.

Conclusion

Tracerco's pig tracking technology provides substantial benefits for operators performing pigging operations where stuck pigs are considered a possibility and where rapid access cannot be guaranteed. Unlike conventional pig tracking technologies which may have as short a battery life as 50 hours, Tracerco's radioisotopes are effectively detectable for well over a year. In most cases, it is possible to locate a stalled pig to within 5cm for as long as it takes to reach the site. The 3000-hour battery life of the GammaTrac™ ensures that rapid pig detection will occur with complete certainty.

With the enhanced functions of the GammaTrac™ unit, useful information such as the pig velocities can be measured which allows the operator to adjust the pumping regime to better control the pigging process.

References

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