THE PINNACLE OF PIG TRACKING
REMOTE NOTIFICATION / CONFIRMATION OF PASSAGE OF AN 8" MFL TOOL

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Abstract

Pipeline operators are constantly evolving their expectations for safer and more cost-effective approaches to ongoing pipeline maintenance. Pigging operations for routine cleaning, gauging or intelligent pigging/integrity management, often requires reliable pig tracking data to maximise efficiency. Reliable, accurate, and timely pig tracking data minimises any potential impact to normal operations. The new developments in pig tracking mean this can now be done remotely without having operatives in the field, reducing risk to personnel, particularly during night-time operations. This paper details the successful online tracking of an 8" MFL tool with no dedicated transponder.

Introduction

Traditionally pig tracking for onshore pipelines is undertaken to ensure the tool location is always known during the run. Onshore lines can have elevated risk of getting stuck compared to more modern offshore environments and preventing flow. Often onshore lines in the UK are of a significant age (up to 75 years), carrying varying qualities of product, which can contain significant detritus. The pipelines often have crossings at roads, railway lines and rivers. Many possible hazards to safe pig passage can arise, including but not limited to; ID changes, excessive line debris, dents, illegal hot taps, uncycled valves, etc.

Background

Pig tracking onshore is usually performed by a team of technicians who are responsible for intercepting the pig at designated points throughout the run. Pig passage is determined through use of geophones and or specialist receiving equipment, typically confirming an Electromagnetic (EM) signal from a Transmitter fitted to the pig. In these instances, the passage can only be verified where pipe is exposed, which is rare in UK cross country pipelines.

Latterly Above Ground Markers (AGM's) have been used as the workhorse product for detection of pigs at pre-determined survey locations above onshore pipelines. Traditional AGM products can detect the passage of pigs with permanent magnetic signatures and electromagnetic transmitters. Pig Passages are recorded to internal memory and time stamped, and this data can later be recovered and combined with inspection data to provide accurate positioning of inspection tools to precisely locate any pipeline defects. Tracking pig location in real time has typically relied on handheld receiver products and geophones deployed by field technicians local to the AGM box. Recovering AGM data, managing true and false passage information, and fusing this data with survey information requires logistical and operational overhead that can be expensive, slow, and does not give any confidence that the approximate location of the tool can be ascertained at a particular point in time.

WSG has been trialling the Propipe APEX AGM system and accompanying web-based software portal in its 1st deployments in the UK. The combination software/hardware system allows pigs to be tracked anywhere in the world where the user has an internet connection and web-browser. Tracking reports are built in real time. Live sensor data, real time passage information and even geophone audio can be streamed to users instantly. The need to download and organize data after a pig run is eliminated, which reduces the overhead of managing data from pig runs, this leads to faster and more efficient pigging operations.

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Figure 1: Propipe APEX remote AGM unit

Detection of Pigs using this system can be achieved with either attached permanent magnets, multiple frequency EM transmitters or geophones. Geophone audio data and waveforms can be transmitted in real time over the internet. Data can then be sent to the end user over several flexible communication channels including cellular. A dedicated web-based platform 'PigView' has been developed to handle and manage all information related to the pigging runs, providing the users with an interface for configuring AGM's, collecting real time data, storing, and managing historical pig tracking data records as well as managing live real time pig runs over the internet.

Conventional method of pig tracking methods centre around moving along the pipeline with the pig. This can be a difficult process for the survey team, presenting possible logistically challenging and even dangerous situations. This specific project spanned several days, meaning that both day/night shift crews would normally be required to track the pig, speed of pigs can be unpredictable and subject to change. Sometimes resulting in tracking teams having to "chase the pig" in order to catch up, which can lead to safety incidents. Onshore pipelines can traverse remote locations, leading to these sites being more difficult to access and reducing the time the pig tracking team has to get into position (Ref Figure 2 below). The system reduces the requirement for long hours of field work and other associated safety challenges around pipeline access.

Aim

The purpose of this project was to confirm that the AGM remote tracking boxes and web-based system could successfully map the progress of an MFL tool with no dedicated transmitter (not able to be installed due to launch/receive pig trap length) through a 114km mostly buried (varying depths) 8" pipeline. The line carries JetA-1 product cross country between storage facilities. This ILI run was scheduled as part of a planned lifecycle integrity plan. It was essential to the client that the tool could be located quickly if any issued were to arise

Diagram

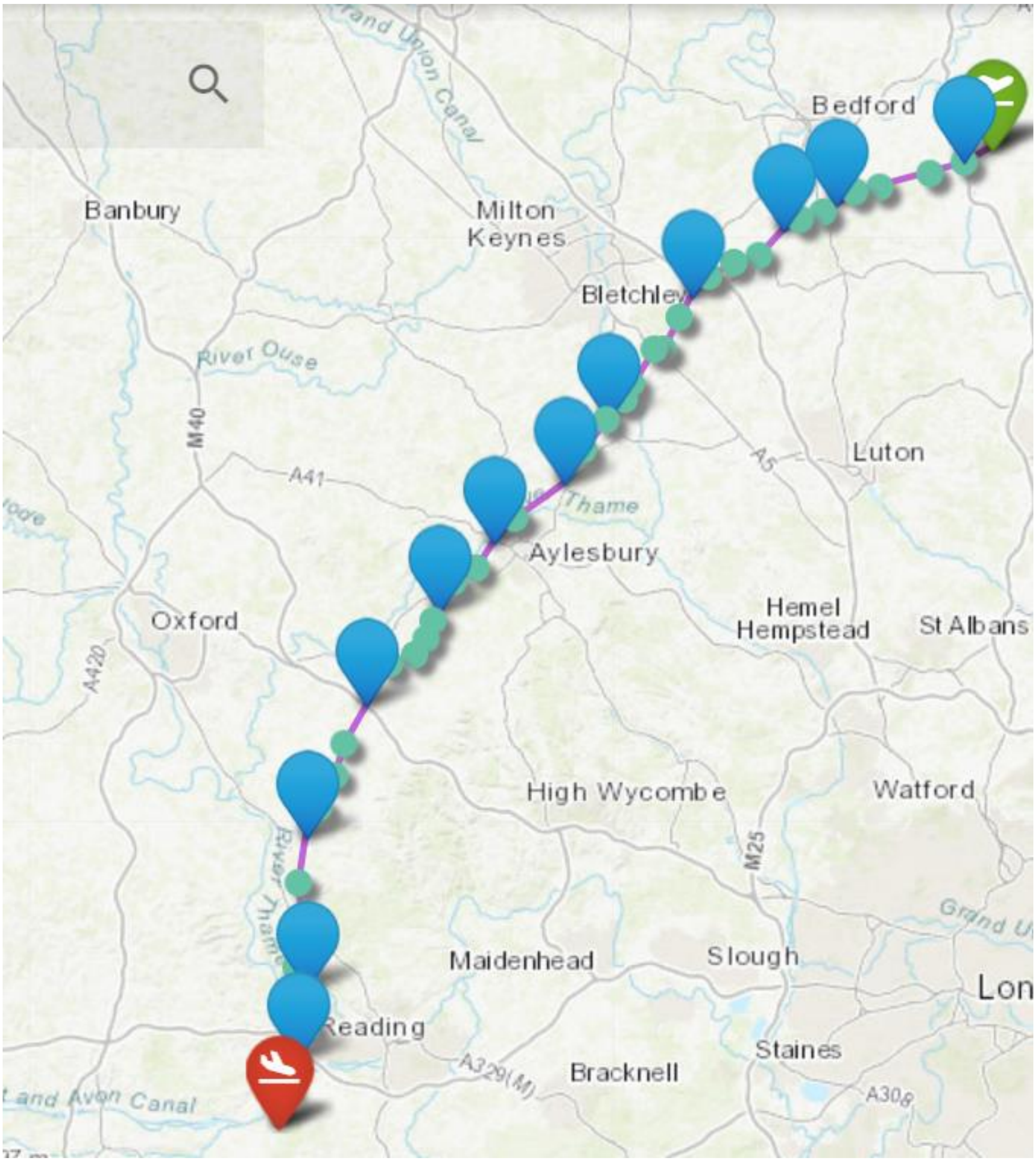


Figure 2 – Web based application for remote tracking

Procedure

- Load tracking point coordinates into web app
- Sense check against known client data
- Confirm launch of tool (handheld pig tracker) and activate previously inputted online tracking program
- Lay out AGM(s) at predetermined waypoints
- Ensure each AGM is active and matched to an intersecting set of coordinates
- Return to track point #1 and await confirmation of passage
- Liaise with pumping control, establish differential between projected and actual flow rates
- Confirm passage of MFL tool via magnetic signature and or geophone (text, email or manual passage)
- Rendezvous with upstream track points as required, until confidence in auto verify system established
- Retrieve AGM(s) and redeploy ahead of the tool as required
- Confirm receipt of tool (handheld pig tracker) discontinue run

Figure *3*: AGM set up in remote location

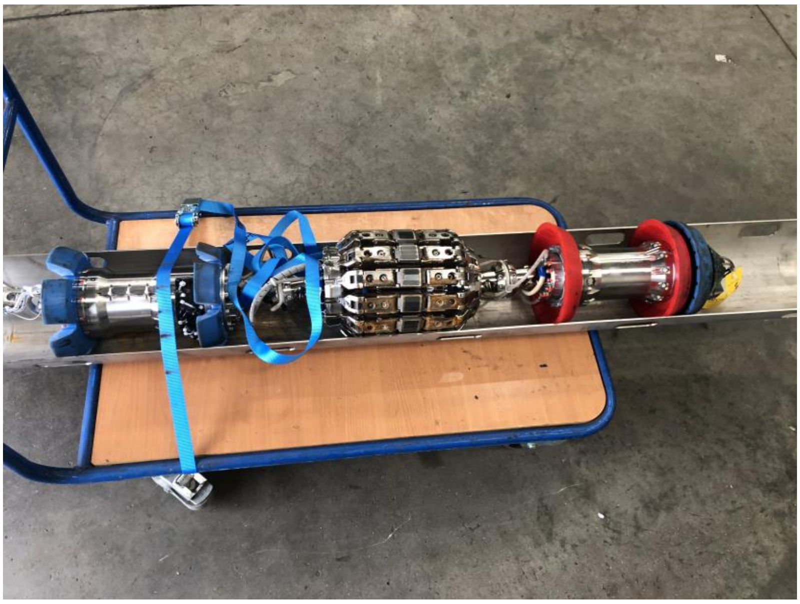


Figure *4*: 8" ROSEN MFL inspection tool tracked during the operation

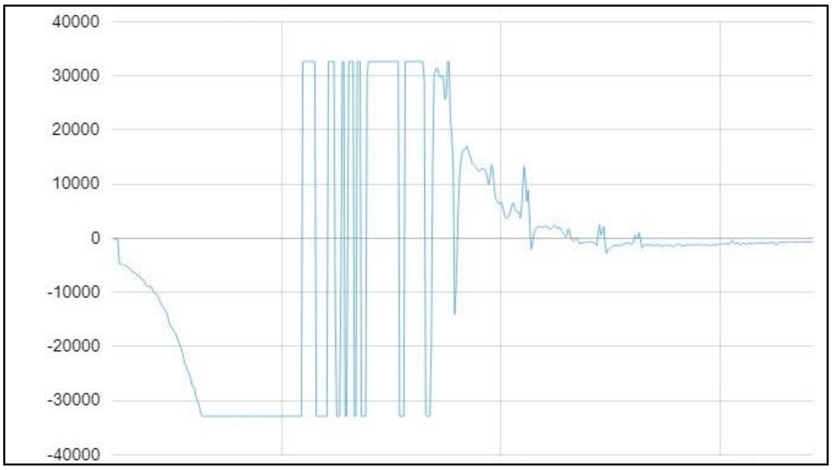
Figure *5*: AGM set up in remote location

Results (Table 1)

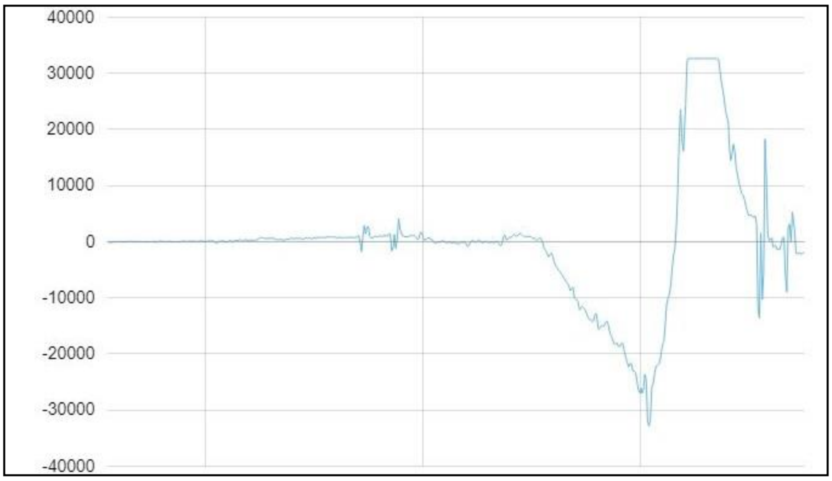
Marker Name	Location Type	Tracker Name	Distance (m)	Projected Speed (m/s)	Actual Speed (m/s)	background dBm	Passage Time GMT	Aproximate pipe depth (m)	Detection Count	Passage Type	Notes
Launcher	N/A	N/A	0.00	0.91	0.66	0	20/07/2021 18:45				
Track Point 1	*Road Crossing*	*205*	*6662*	*0.91*	*0.54*	101	20/07/2021 21:21	1.5		Manual Passage	auto verify overriden
Track Point 2	*Valve box*	*204*	15431	0.91	*0.45*	103	21/07/2021 00:53	2		Manual Passage	auto verify overriden
Track Point 3	*Road Crossing*	*206*	18392	0.91	*0.66*	101	21/07/2021 02:06	1.5		Manual Passage	auto verify overriden
Track Point 4	*Road Crossing*	*203*	*25710*	*0.91*	*0.66*	79	21/07/2021 04:59	1.5	89	Automated	pig speed recalculated
Track Point 5	*Valve box*	*206*	30418	*0.91*	*0.66*	97	21/07/2021 06:52	0	39	Automated	n/a
Track Point 6	*Road Crossing*	*205*	*35412*	*0.91*	*0.66*	83	21/07/2021 08:53	1.5	40	Automated	n/a
Track Point 7	*Road Crossing*	*204*	*43528*	*0.91*	*0.66*	81	21/07/2021 10:35	1.5	93	Automated	n/a
Track Point 8	*Road Crossing*	*207*	*49870*	*0.91*	*0.66*	85	21/07/2021 12:06	1.5	22	Automated	n/a
Track Point 9	*Road Crossing*	*203*	*57926*	*0.91*	*0.66*	81	21/07/2021 14:38	1.5	45	Automated	n/a
Track Point 10	*Road Crossing*	*204*	69783	*0.91*	*0.66*	105	21/07/2021 17:56	1.5	40	Automated	n/a
Track Point 11	*Road Crossing*	*205*	76067	*0.91*	*0.66*	105	21/07/2021 22:38	1.5	71	Automated	n/a
Track Point 12	*Above Ground Pipe*	*206*	82610	*0.91*	*0.66*	105	22/07/2021 01:08	0	95	Automated	n/a
Track Point 13	*River / Road Crossing*	*207*	88400	*0.91*	*0.66*	87	22/07/2021 06:03	2+		Manual Passage	no detection due to sifnificant Depth (geophone verified)
Track Point 14	*Road Crossing*	*204*	96027	*0.91*	*0.66*	83	22/07/2021 11:26	1.5	50	Automated	Automated
Receiver	N/A	N/A	114245	0.91	0.66	0	22/07/2021 14:03				

Results

Graph 1 - Track point 1



Graph 2 – track point 2



Graph 3 – track point 3

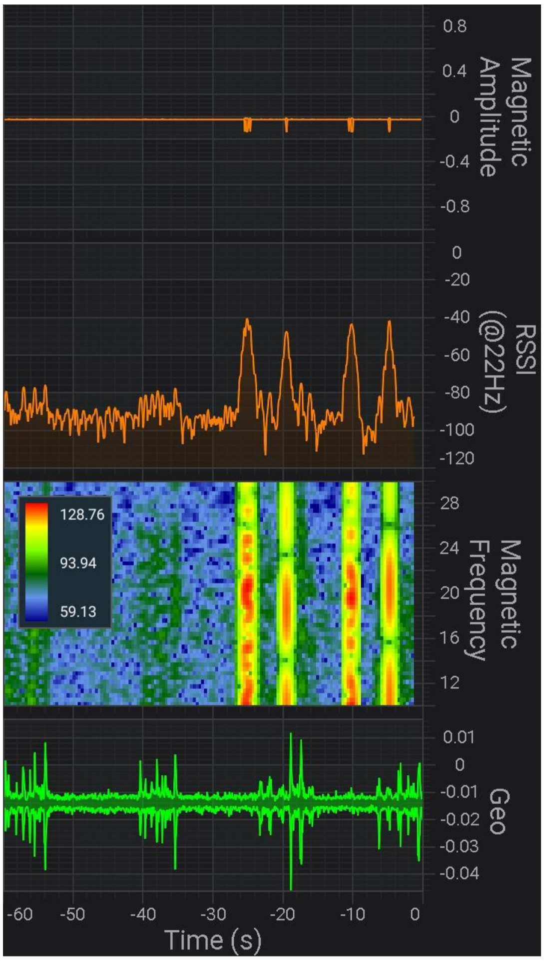
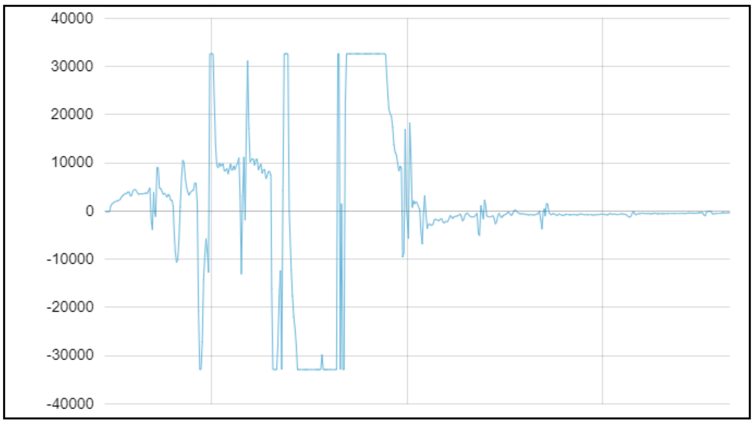
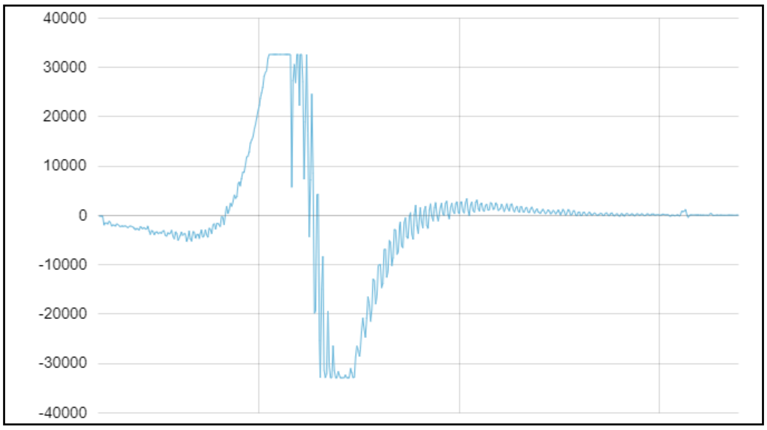


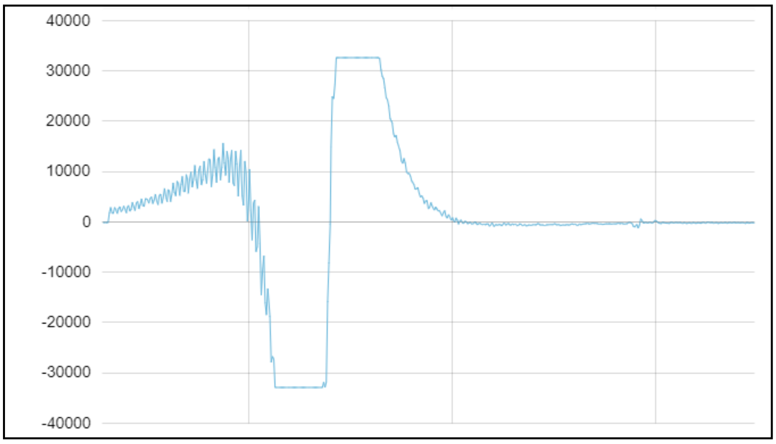
Figure *6*: real time data (TP3)



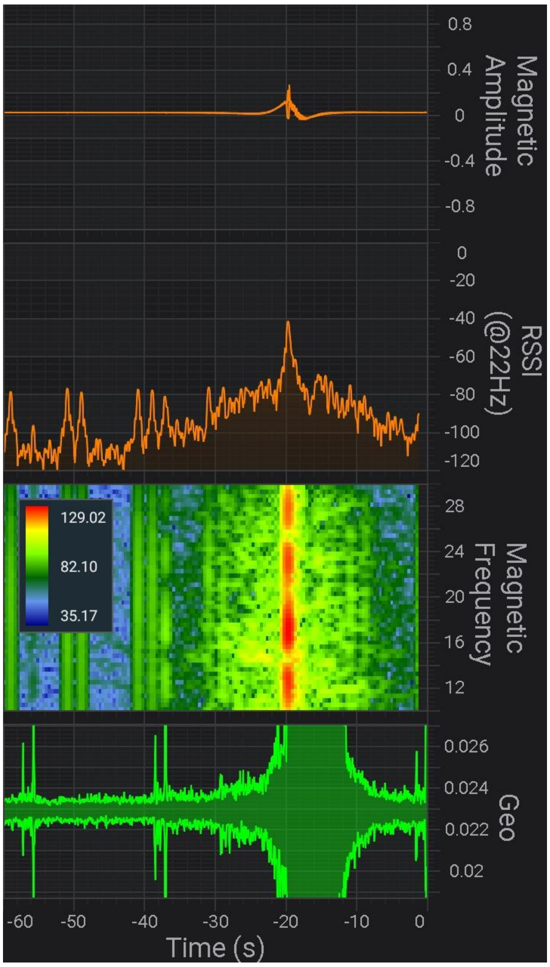
Graph 4 – track point 4

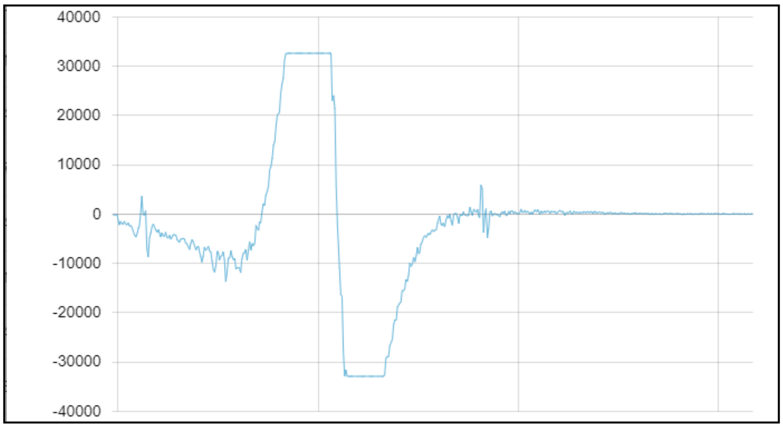


Graph 5 – tracking point 5

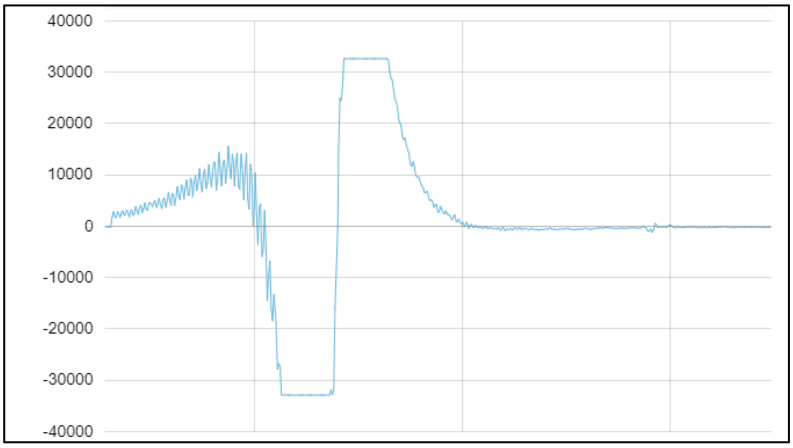


Graph 6 – tracking point 6

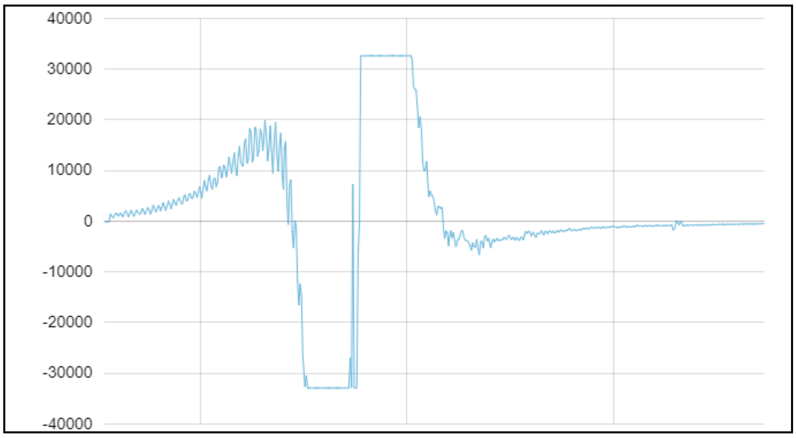




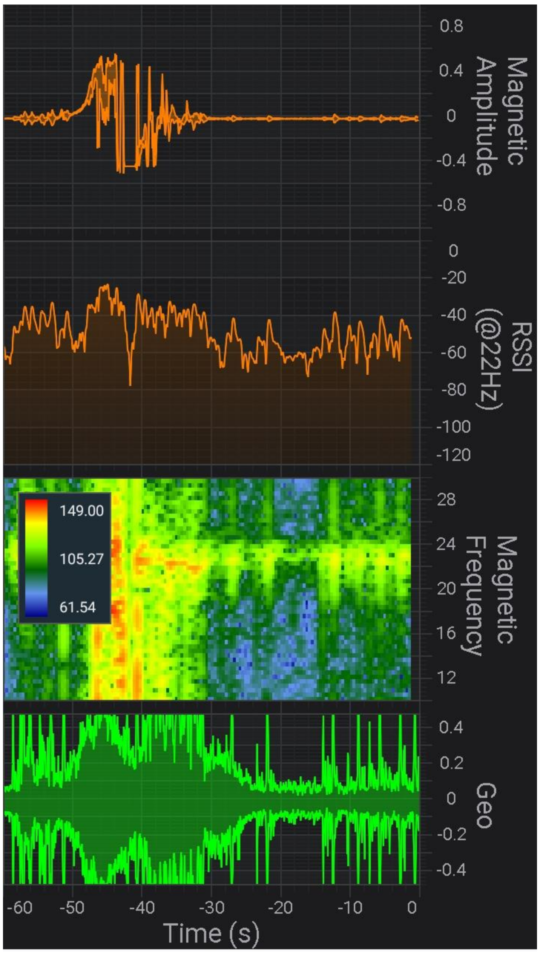
Graph 7 – tracking point 7

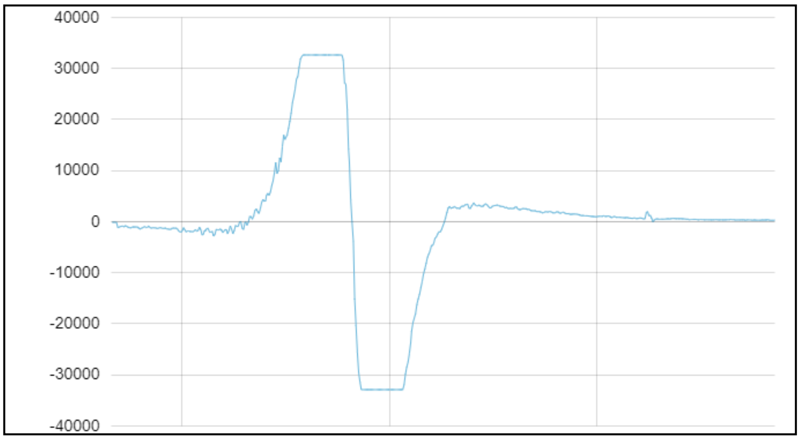


Graph 8 – tracking point 8

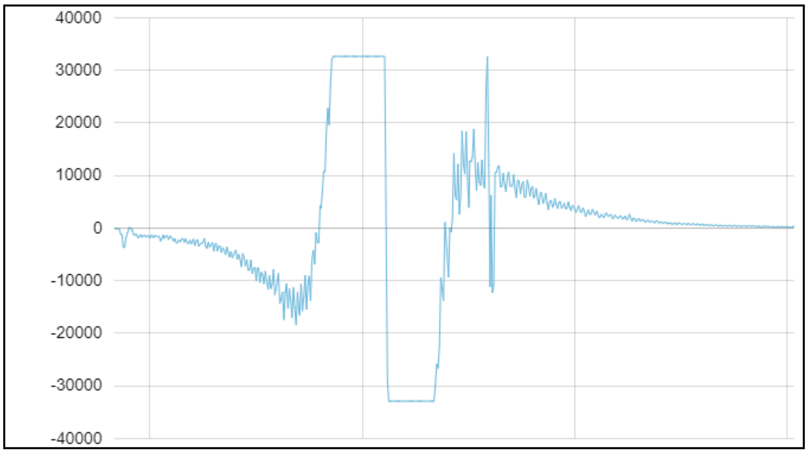


Graph 9 – tracking point 9

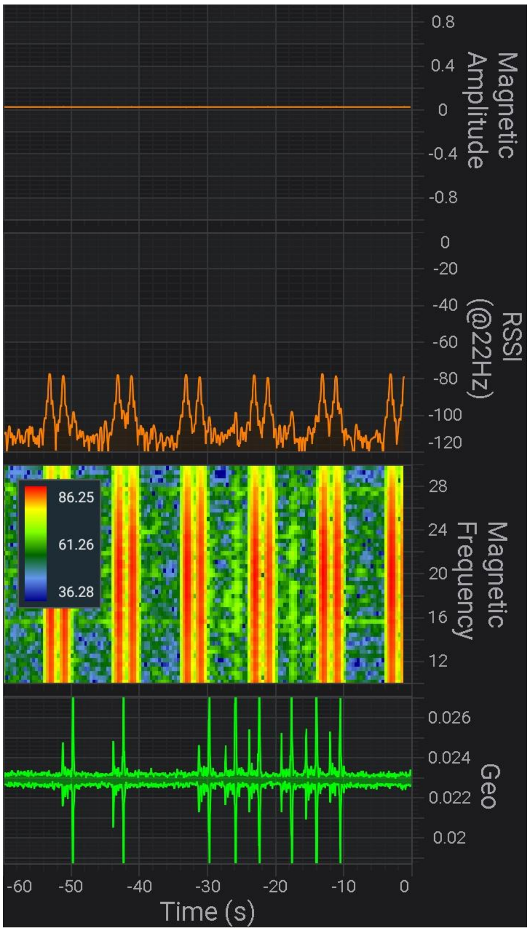


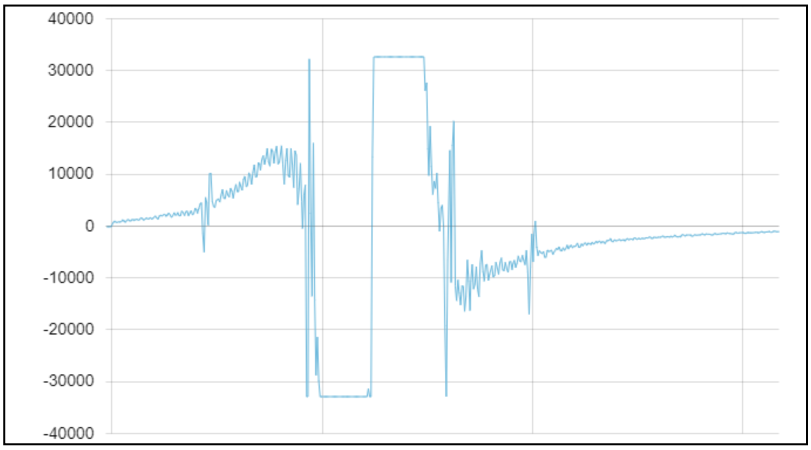


Graph 10 – tracking point 10

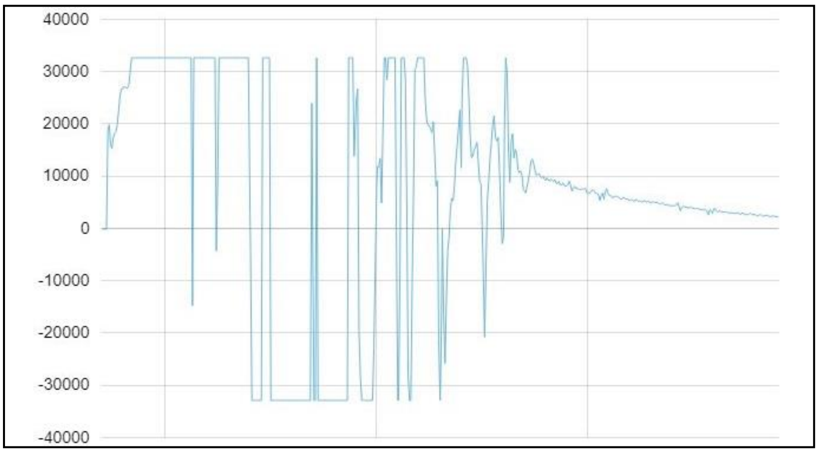


Graph 11 – tracking point 11

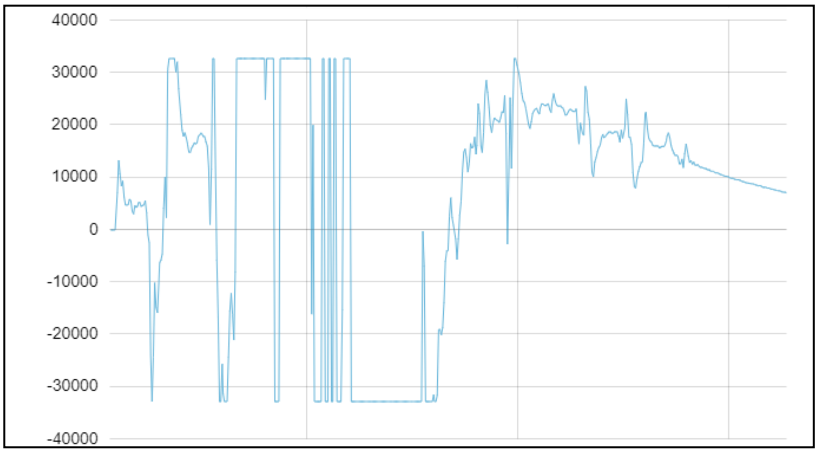




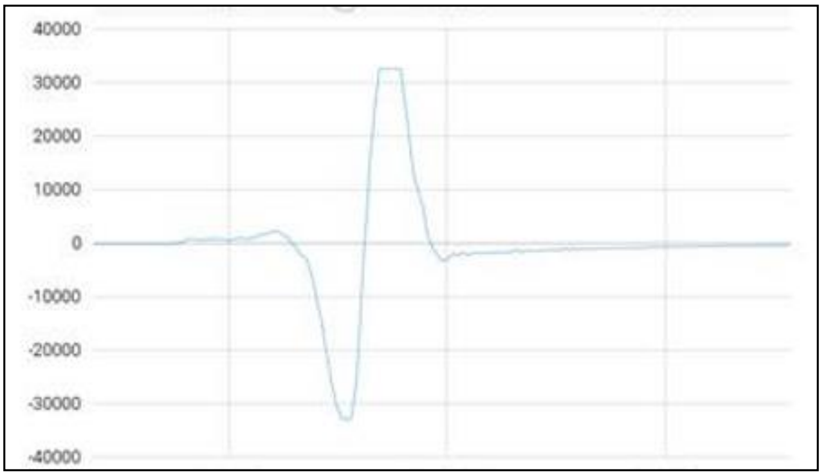
Graph 12 – tracking point 12



Graph 13 – tracking point 13



Graph 14 – tracking point 14



Graph 15 – MFL tool test - in air at 10m distance

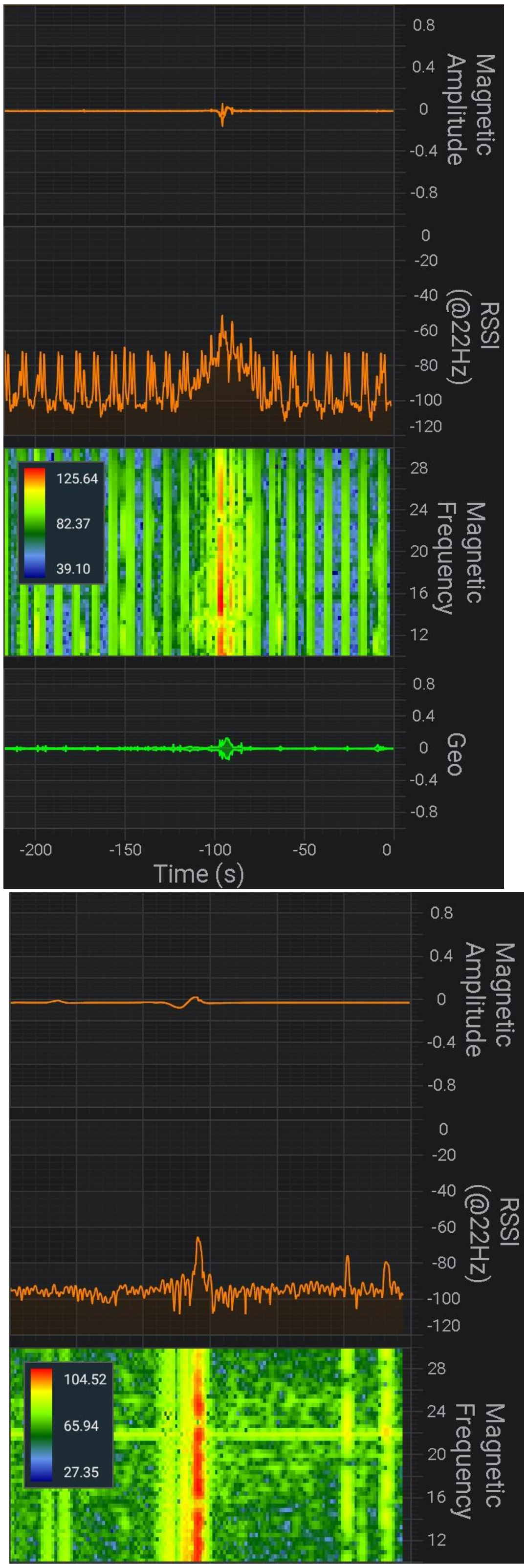


Figure 11: real time data (TEST)

Discussion

At TP1, TP2, TP3 manual verification of the passages had to be input through the online platform as the planned speed of the pig at the beginning of the run was not being achieved by the inline fluid pumps, it was not confirmed until TP4 that this was the case. The pig speed was expected to be 0.66 m/s and was actually 0.45 m/s initially meaning the pig arrived at the first three track points significantly after the planned ETA. In this instance the software holds the pig at that point until the passage is manually verified. However, the magnetic and geophone signals were strong and recognisable when the MFL tool passed the AGM regardless of the software / notification complications.

In this application with no EM transmitter being present in the tool, only tracking by magnets & geophone was possible. As the majority of the pipeline is buried at depths greater than 1.5m, it was initially thought that the Geophone would be the primary method for detection. However, you can see the above data demonstrates a clear magnetic signature could observed at all track points, TP13 was a spurious result, Due to it being a busy main road crossing. We believe multiple passing heavy goods vehicles before, after and during the expected time of pig arrival, triggered the box as the magnetic signature did not correspond with other track points or the geophone data for that location when the pig did actually pass. Hence the requirement for a manual verification.

At every track point aside from TP1 the magnetic signature measured above the maximum point of 32000 (absolute instrumental value) meaning the tool saturated the detector. We believe the differenced in signature is due to low speed of the pig at the passage point as well as possible pipe depth (at a road crossing).

Graph 15 and figure 11 give data form the test carried out on the Apex AGM box interaction with the MFL tool in a workshop environment giving a degree of confidence that system would be viable prior to the run (Note no geophone installed due to lack of pipe tool interactions).

SMS, email notifications, and group pig passage information were disseminated to the interested parties in real time without issue.

Conclusions

The MFL tracking run using the remote pig tracking was successful, with detection of the tool being made with magnetic signatures as well as geophones at every chosen track point.

The use of this system reduced the number of people required in the field for the run, have the dual added benefits of reducing costs and improving the safety of the whole operation. As well as giving real time data on tool location with increased accuracy in the case where any issues were to occur.

The addition of a pause button for the online system would allow any pig hold up due to pumping issues to be managed in real time. Also, an ability to modify the projected pig speed online are required to allow the system to become more accurate for future track points in the run.

Careful selection of tracking points is required to avoid spurious / false detections e.g. railway lines, busy roads, particularly those used by heavy goods vehicles.

Utilising the Remote AGM system, the risks outlined above can be significantly reduced. The pig tracking technicians are only required to be onsite to deploy the equipment, which can be done in day light and good weather, therefore minimising risk associated with “pig chasing” and also 24hour working.

As well as reducing risk of traditional pig tracking methods, which typically utilise teams of technician, the system can reduce costs, only one technician is required to deploy and collect the equipment (with minimal time pressure). The management of the pig run itself performed online by a single user, this results in a reduction of manpower, vehicles movements and environmental footprint.

While the use of traditional tracking methods is common place, best-in-class integrity programs should be leveraging remote pig tracking to reduce cost and increase safety.

Special Mentions

This paper was written with technical support and data from ProPipe, Exolum UK, Rosen. References are also made World Pipelines magazine article “Advanced Platform for Pig Tracking” – October 2021.