# Dynamic Speed Control in High Velocity Pipelines
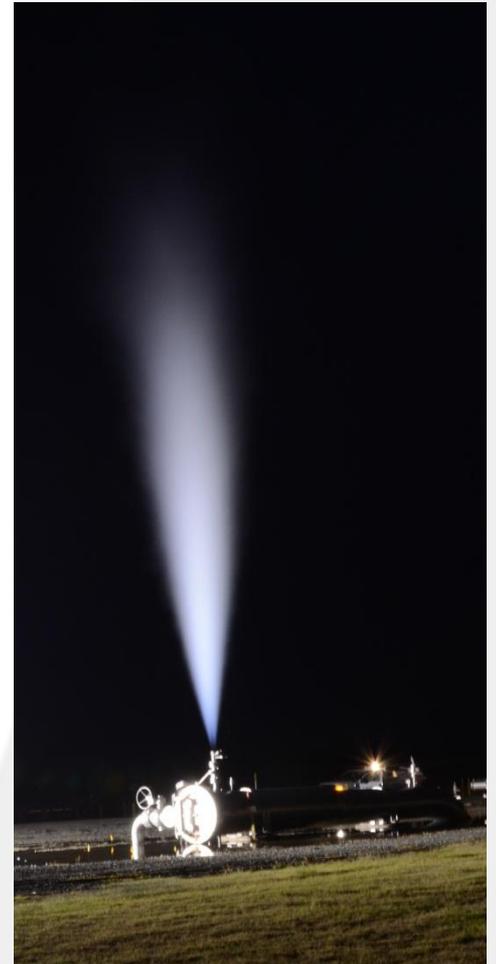
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INTELLIGENT PIPELINE SOLUTIONS

- Brief Introduction To Pipelines2Data

- Brief Introduction To P2D Technology

- The Problem Of High Velocity Gas Pipelines

- The Solution

- Theory Of Operation

- Performance Of The Speed Control Pig

- Enhancements

- Conclusions

# Background

- P2D was formed in January 2007

- Obtained ISO 9001 in June 2007

- Obtained ATEX and IECEX accreditation for all pipeline data gathering tools in July 2008

- Currently consists of 25 employees & 2 sub-contractors

- Offices located in Aberdeen at the Technology Centre Bridge of Don - office & workshop space 5,502 ft$^2$

- Moving to new offices in December: 5165 ft$^2$ of office space 9996 ft$^2$ of warehouse space

# P2D's Pipeline Data Gathering Tools

P2D have a suite of tools designed and developed for use in 'Intelligent Cleaning'

- Pipeline Environment Tool (PET)

- Debris Mapping Tool (DMT)

- Advanced Geometry Tool (AGT)

- Pipeline Profiling Tool (PPT)

- Speed Control Pig (SCP)
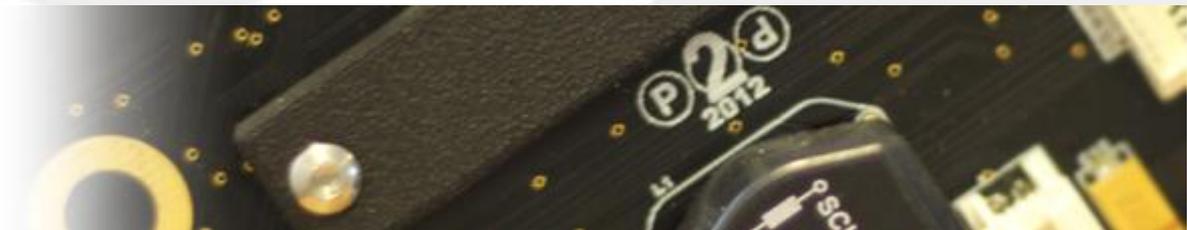
# The Problem

Some high pressure high flow gas pipelines have flow rates of more than 24mph (11 m/s)

- Receiving a pig travelling at these speeds is difficult and dangerous

- Putting fixed bypass into pig body to reduce pig velocity to appropriate speeds would present major launch and receipt problems

- Traditionally pipeline flow has been reduced to reduce pig speed, but this has significant cost implications

- Effective pipeline cleaning occurs at much lower speeds, approximately typically less than 11mph (5m/s)

# The Solution
# The Speed Control Pig (SCP)

- The SCP allows dynamic variable bypass through the pig body

- Bypass area is automatically determined by the speed of the pig though the pipeline

- Desired pig speed is entered into control software. The SCP then controls the vane position to maintain this speed

- SCP logs environmental data and slope data providing a mass of additional pipeline information post run

# Theory of operation
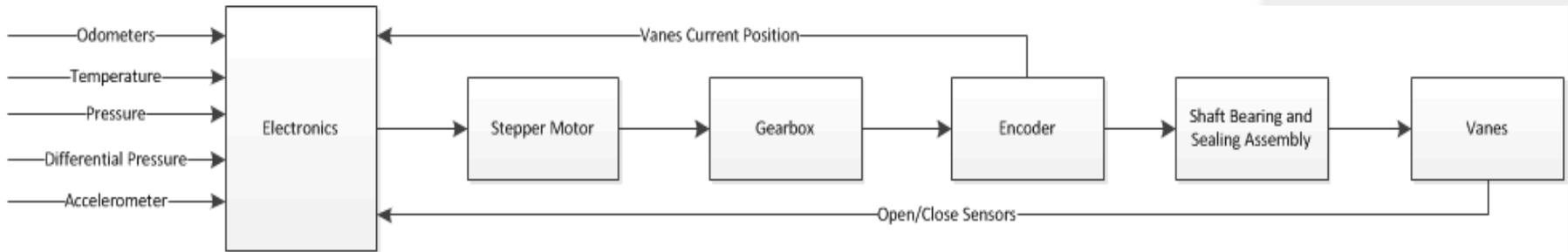


- Custom designed FPGA based electronics provide control and logging electronics
- Sensor information logged to CF card for download and processing after run
- Encoder used to give actual vanes position
- Dual redundancy insures against failure
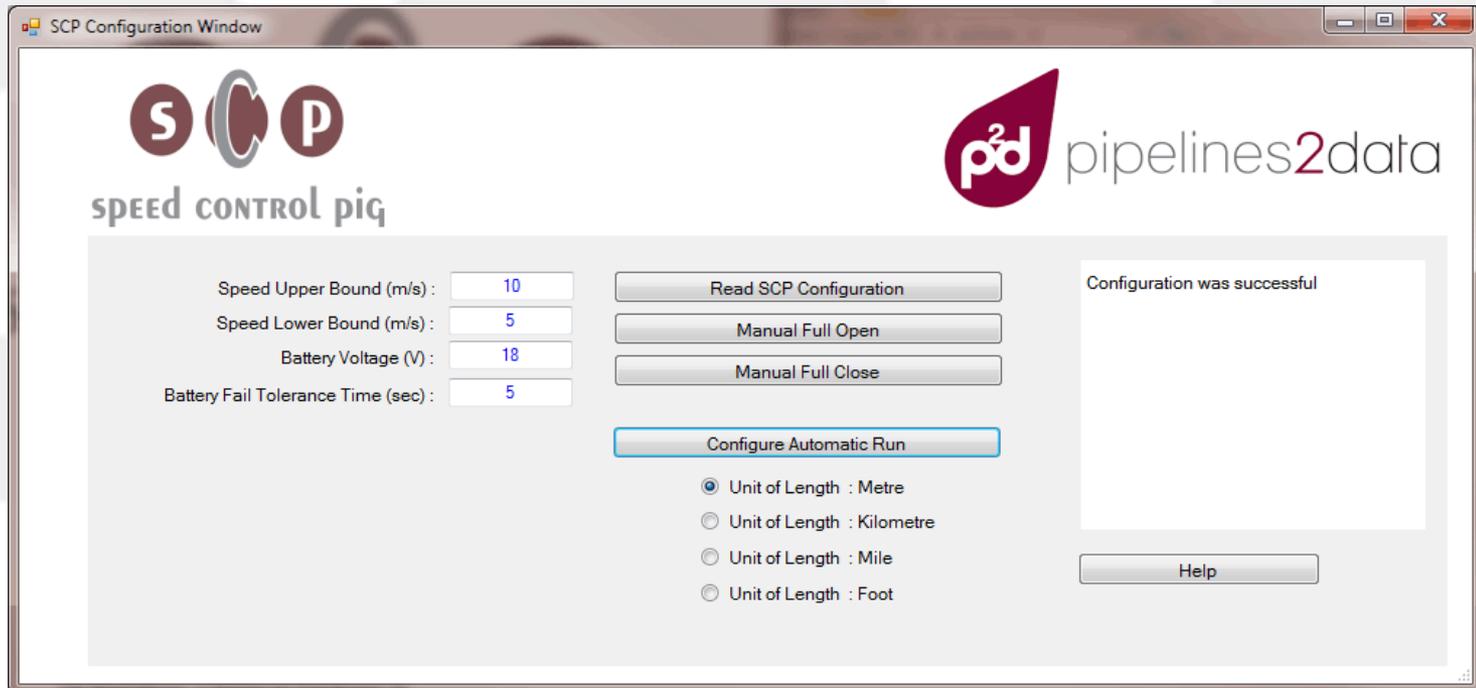- Control Mechanism uses speed to adjust vane position
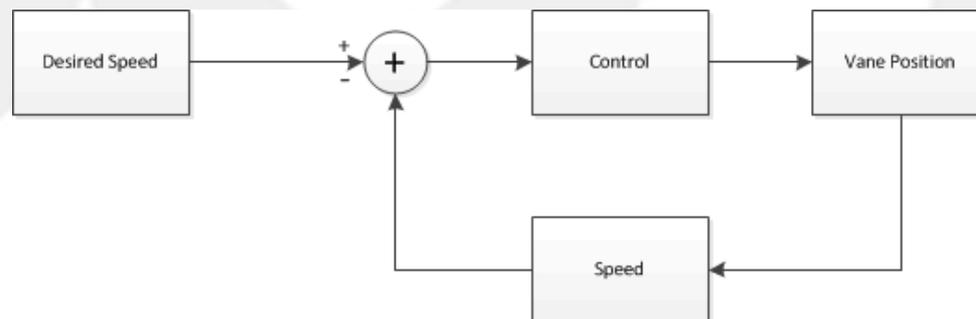
# Speed Control Pig

# Configuration

- Simple Ethernet connection to electronics

- Quick set-up of the tool prior to run using custom P2D Software

- Simple download of data from tool using the same software

- Software interface shown below

# Launch and Receipt

- SCP utilises the clients approved pigging procedures

- Tool designed to be ATEX compliant, though not yet ATEX approved as runs so far have been in the USA

- No special equipment required to launch or receive the tool

- SCP is launched and received in the same way as a standard cleaning pig

- Data can be downloaded and analysed very quickly after receipt.

- Tool can be re-launched into another section within hours.

# Performance



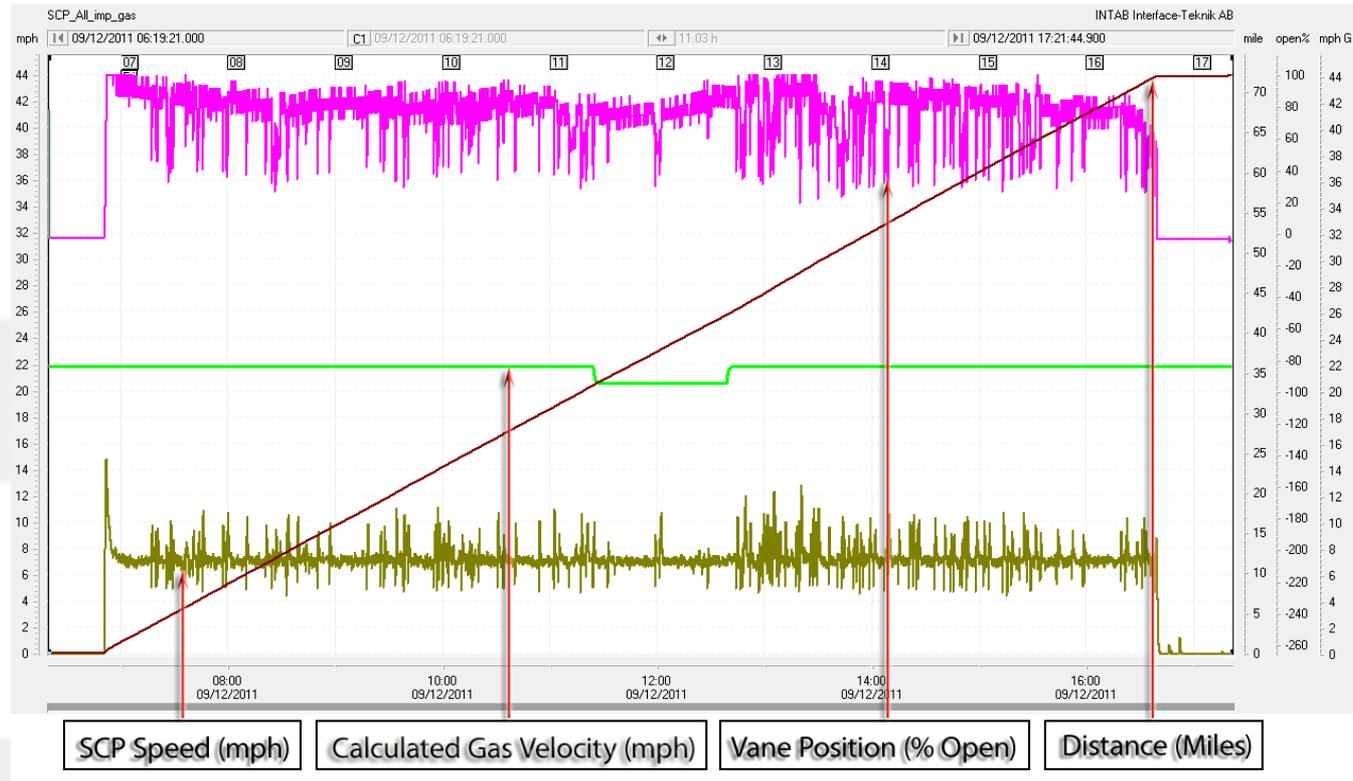SCP Speed (mph)   Calculated Gas Velocity (22mph)   Average Run Speed (7.3mph)
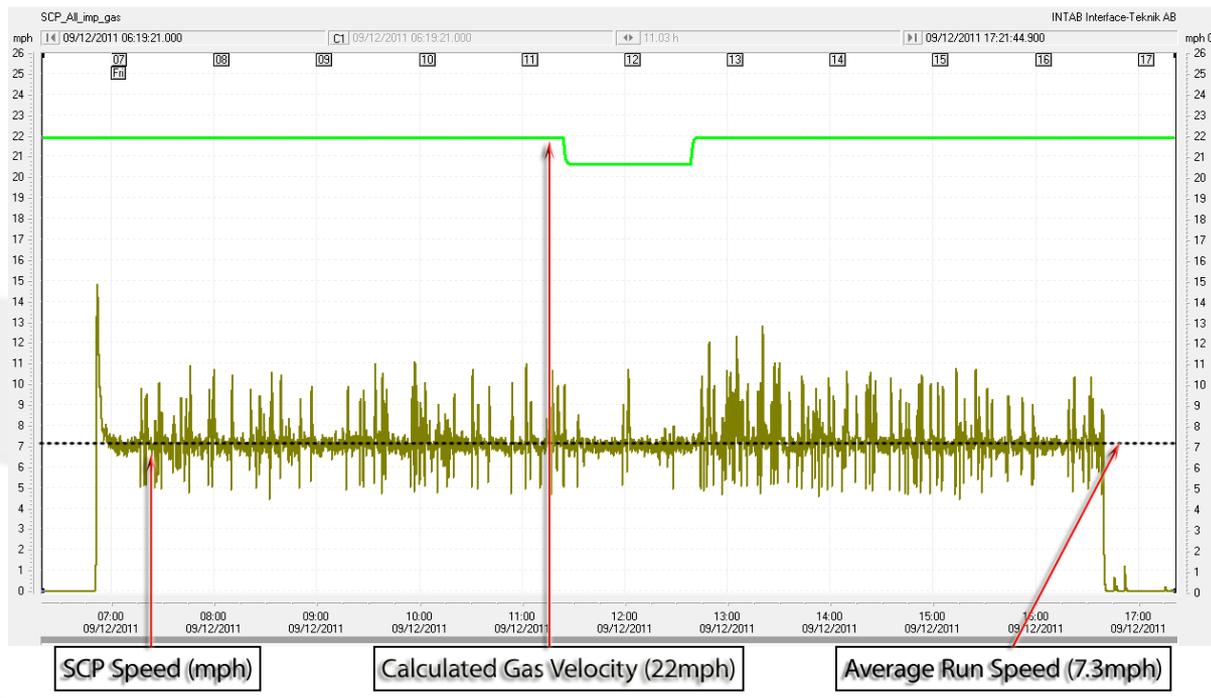
- Gas velocity calculated from limited information provided by client

- SCP reduces speed very effectively to an average of 7.3mph (3.4m/s)

- It is almost impossible to prevent some speed excursions due to the compressible nature of gas

# Performance 2



- Vane position effectively adjusts to control the SCP speed during the run

- Cause of speed excursions are changes in pipeline slope and wall thickness

# Track record

Over the past 3 years, partly in conjunction with a pipeline operator, the SCP has been run a number of times in pipelines across the United States. Currently there are 42" and 36" configurations.

- 2010    3 sections of 42" total distance approximately 172 miles

- 2011    4 sections of 42" total distance approximately 336 miles
          3 sections of 36" total distance approximately 246 miles

- 2012    3 sections of 42" total distance approximately 269 miles

# Enhancements

The SCP can provide a useful vehicle for a variety of different situations

- Standard configuration with "DC" cups is ideal for removal of loose debris and wax

- Increased cleaning effectiveness through adding brushes to improve sweeping effect

- De-scaling and hard debris removal by adding pins or scraper blades

- Black powder removal by adding high strength magnets and heavy duty pencil brushes

- Pipeline cuttings and hot tap debris removal again with the addition of high strength magnets and brushes

# Debris and Geometry Measurement

The SCP has a large area of unused space that is suitable for the mounting of other sensors to provide pipeline profiling options

- P2D calliper sensors – Provide accurate pipeline diameter for ovality and deformation measurement.

- P2D debris sensors – Provide accurate measurement of debris build-up in the pipeline.

- Together both sensors give a wealth of information on the pipeline condition, providing the operator with invaluable information on their pipeline or pigging programme effectiveness.

# Conclusions

The SCP is a hugely versatile tool able to control its speed in demanding conditions

Additionally it provides a stable platform to mount advanced sensing solutions to allowing accurate pipeline measurements to be taken.

It can also act as a tractor to tow other vehicles and technology with no change to the electronics or control system

The SCP is ultimately a 'vehicle of opportunity': it can be specifically configured and tailored to suit the client's application and satisfies many requirements on one run.

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