Dynamic Speed Control in High Velocity Pipelines

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• 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 ft²
- Moving to new offices in December: 5165 ft² of office space 9996 ft² 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 24 mph (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 11 mph (5 m/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 through 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
• 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**

- 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
• 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.