WHITE PAPER

Isolate and Displace – The IsoPurge

Utilizing Isolation Tool Technology in Conjunction with Nitrogen Purging

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ABSTRACT

Re-routing and replacing sections of aging and compromised pipe is a reality often faced by pipeline companies. This may be due to integrity concerns identified by smart tools, an alteration in civic infrastructure, or a change in commodity demands. Common locations include major road crossings, waterways, and high consequence areas (HCA's). Often the least intrusive method of replacing relatively short segments of pipe is to horizontal directional drill (HDD) a bore path and pull new pipe through, with the purpose of abandoning the defective section of pipe in place. Thus the need arises of isolating the existing asset to facilitate cutting the pipeline for welding in the replacement pipe. There are 2 traditional ways to isolate an active section of pipe: purge the line using nitrogen, or use full-bore split tee hot taps. More recently using in-line isolation pigs has become an attractive option from integrity and costs perspectives.

Integral Pipeline Technologies has integrated using its IsoTool™ with nitrogen purging to greatly reduce the purge length, while simultaneously displacing the product in the cut out section.

TRADITIONAL METHODS

- Conventional Purge – This involves purging from one valve to the next valve with the tie in somewhere in the middle, which can be effective in small diameter pipe, and when valves are close to each other, but in larger diameter pipelines, or when valves are greater distances apart, the project costs and down time may be of greater concern.
- Split Tee Line Stop – The use of full-bore hot taps has been standard operating procedure for many years, and is a safe and tried method of isolation, but it requires welding fittings onto a live line, and leaves completion coupons on the line which may create future pigging and integrity concerns.

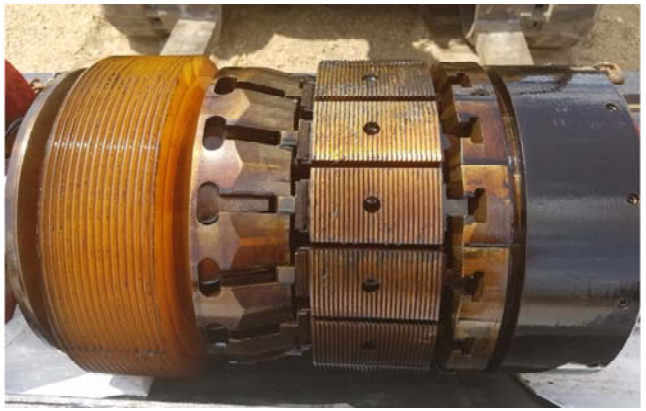
THE ISOPURGE

Two IsoTools are launched a set distance apart and the upstream tool is parked upstream of a TOR fitting. The US Tool is remotely set and thus becomes the backstop for purging the DS tool. Nitrogen is injected between the IsoTools, and the downstream tool is propelled to the other side of the tie-in, while displacing the product to tank, or down the pipeline. The DS tool is set, nitrogen is vented to atmosphere, and the mechanical work may commence.

ISOTOOL BACKGROUND

Designed for on-shore fluid applications, The IsoTool is an in-line autonomous pig that acts like a positionable valve that holds back fluid pressure.

A central internal screw is turned by means of an electro-mechanical drive system, which draws the length of the head module shorter. As the tool shrinks in length, grip arms slide up ramps until they contact the pipe wall. The grips are made of aluminum-bronze, which is slightly softer than the steel, and have been certified to not gouge into the ID of the pipe.



Once the grips have connected with the pipe, the axial force of the tool extrudes the urethane sealing element until it creates a bubble tight seal against the pipe wall.

An Isolation Assurance Test is completed, whereby the pressure on the tie-in side is bled to zero and monitored.

A TYPICAL 1 ISOTOOL™ PIPELINE ISOLATION PROCEDURE

Launching The IsoTool is launched as any ILI would be.

Tracking and Parking IsoTool The IsoTool is tracked as it proceeds toward the repair area, where it will be parked on either side of the other isolation point (usually a main line valve).

Isolation Nearest US and DS mainline valves are closed and LOTO. The IsoTool is set in 1 hour.

Isolation Assurance Test Pressure is drained to zero between the IsoTool and the other isolation point and pressure is monitored for 30 minutes. IsoTool is LOTO.

Double Block and Monitor The pressure between the IsoTool and the next DS or US valve, will be monitored, providing a double block-and-pressure-monitor.

Mechanical Work The tie-in crew will complete repairs.

Refill & Pressure Equalization Product is returned to the volume between the IsoTool and the other isolation point. LOTO is removed from the IsoTool. IsoTool bypass is opened to equalize pressure across the pig.

De-Isolation The IsoTool is unset in 1 hour. All valves are de-LOTO and opened. Operation returned to Pipeline Control and the pig will be pumped to the trap.

APPLICATIONS

Leaking Trap Valves
Problem MLV's
Pipe Replacement
Anomaly Repairs
Re-Routes
Tie-Ins

TECHNICAL SPECIFICATIONS

8" through 26" available
Max. dent traversable: 10%
Max. traveling pressure: 1000 psi
Min. single bend traversable: 3D
Temperature: 32°F to 130°F (0°C to 54°C)
Max jobs before battery service: 3
Communication distance in 3/8" wall: 6-8'

COMMUNICATION SYSTEM

A powerful 2-way communication system is used to give instructions to The IsoTool, and retrieve status information from its onboard sensors including:

- US & DS line pressures
- Power draw on tools during operation
- Set current
- Battery voltage
- Internal bypass valve position
- IsoTool internal temperature

CASE STUDY

Pre-Launch Assessment

An in-line inspection tool detected longitudinal seam weld cracking in 20" pipe that was beneath the I35 interstate. The pipeline company performed a 1500' horizontal directional drill (HDD) beneath the highway and pulled through new pipe. In order to cut the existing pipe and tie in the new pipe Integral Pipeline Technologies was consulted to assess the feasibility of integrating isolation tool technology with nitrogen purging. A thorough project analysis was performed where ILI data was used to calculate the stresses that would be incurred upon the pipeline at the isolation point.

	US IsoTool	DS IsoTool
Wall Thickness at Iso Site (")	0.312	0.312
Pressure Tool Set In (PSI)	200	50
Set Amperage (Amps)	14	14
Max Pressure Tool Held (PSI)	200	50
SMYS at Iso Site	52000	52000
Max Strain at Iso Site	43299	37997
% SMYS	83%	73%

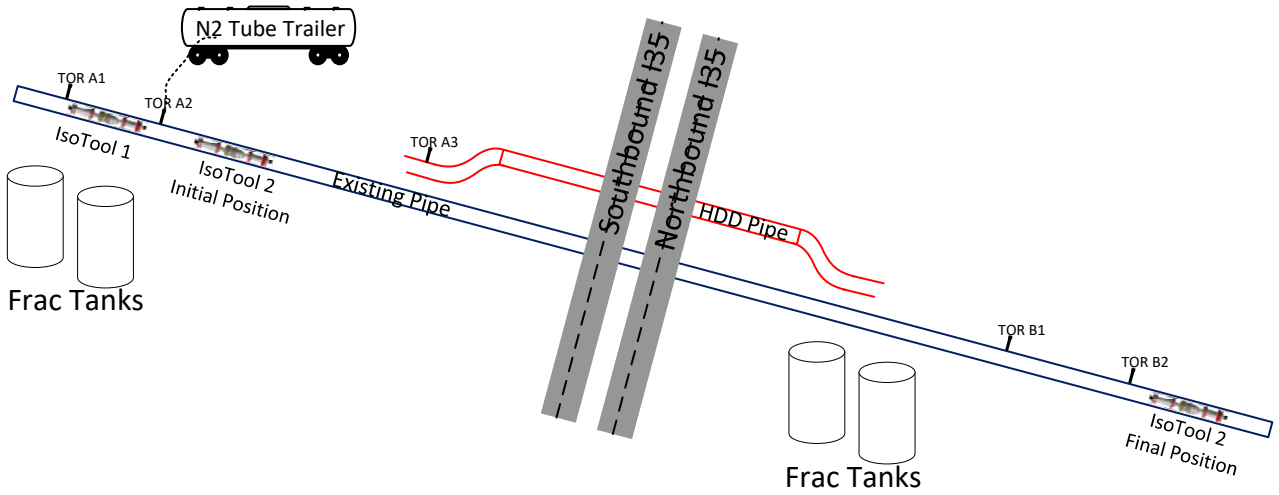
The IsoTools are designed to hold pressure from one direction. After the tools have mechanically actuated, a positive locking system transfers the linear forces to the radial plane, hence the more the tools are required to hold, the greater their holding capabilities. The IsoTools can hold well over 1000psi of pressure, but the limiting factor is the stresses incurred upon the pipe. Integral's assessment of this project was that 200psi of pressure would be 83% of specific minimum yield strength of the steel.

Two 20" IsoTools were built with a non-ported drive disc and cup to provide maximum seal for nitrogen purging, while the remaining discs were slightly undersized to allow for minimal resistance. The IsoTools were shop tested and it was discovered that a differential of 35psi was sufficient to overcome friction and get the pigs to move, and approximately 15psi of differential would keep them moving.

Launching & Parking

The distance from the launcher to the tie-in location was significant, so the client decided to pull the tools into a spool piece at a pump station US of the cutout. The first tool was pumped out 300', the line was shut down, and the second tool was pulled into the spool. The pigs were pumped at normal flow

rates, and tracked by Integral Tracking Technicians, until they reached a point 3.4 miles US of the park location, at which time the line was slowed to minimum rate. When the lead pig passed a tracking location 1700' US of the tie in the line was stopped. By using the residual pressure in the line, and discharging product at the end of the pipeline, the front pig was tracked until it passed a set of TOR's, when a valve DS was closed and the pigs stopped moving. The lead pig was 140'

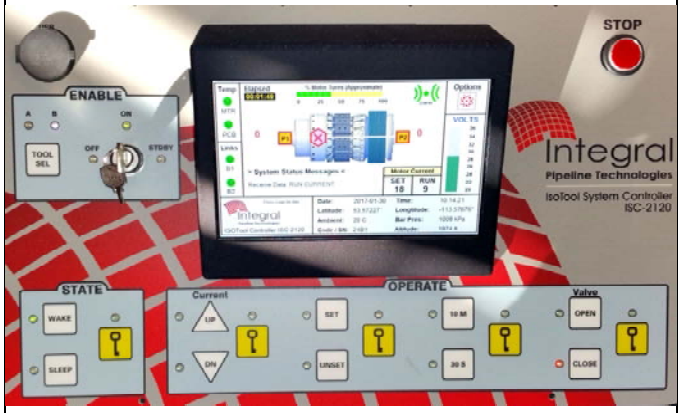


CASE STUDY (continued)

DS of the TOR's and the US pig was 160' US of the TOR's. The US IsoTool was brought into final park position by draining oil to a vac truck to slowly move the pig until it was between 2 TORs. During this process the front pig moved back, and was monitored by the trackers until drain up was complete and the IsoTools were 25' apart.

Setting & Purging

Both IsoTools were wakened and initial readings of US/DS pressures and battery voltages were taken. After a Pre-Set Safety Review with the client, the IsoTool Operator gave the command to SET the US tool.



The tool ran through its complete cycle and sent a confirmation that the set current had been reached and the tool was set in 47 minutes. The internal bypass in the US IsoTool was closed and the pressure DS of the tool was dropped and the 30 minute Isolation Assurance Test was performed.

The US IsoTool was locked out / tagged out, whereby the operator can still monitor the tool's status, but all functions are disabled. The tool was holding back 140psi of pressure on the US side.

A nitrogen tube trailer was connected to the TOR DS of the set IsoTool and the trackers positioned themselves for the purge to begin. Frac tanks had been staged on the DS side of the highway and 2 TOR's were plumbed in to act as the discharge point for the purge. The nitrogen was regulated to 150 psi to ensure that the pressure against the US IsoTool was not greater than the pressure it was holding. At 125psi of purge pressure the DS IsoTool moved smoothly through the section of pipeline to be abandoned, with a pressure of 95psi on the discharge manifold. The DS IsoTool took 1 hour and 40 minutes to travel the 1500' and clear the DS tie in location. When the drive cup and disc passed the discharge TOR the pig stopped immediately and the gas went to tankage. There was zero bypass of gas past the purged IsoTool. The procedure called to park the DS IsoTool past the TOR, so product was removed DS of the tool, but it did not move. A very short injection of N2 helped push the pig and additional 42' into its final parking position. This tool was then set in 58 minutes, which was expected to take longer than the US tool, since it was in gas, and the lubrication efficiency of the oil was not present. Once set, the Isolation Assurance Test was perfromed, but this had to be a visual inspection, since there was no product on the US side to reflect a pressure change. A TOR US of this tool was monitored to determine if there was any bypass or leaks. The internal bypass in the tool was closed, the System Controller was locked out, and the N2 was vented to zero. The tool was holding 108 psi and no fluid was passing by the tool,

The mechanical work was completed and the new pipe was tied in. Two vapor tools were utilized for the tie in welds.

CASE STUDY (continued)

Filling & Unsetting

Once the welds passed radiographic testing the volumes between the pigs needed to be filled. A jumper hose was used across the US IsoTool to fill the pipe between that tool and the US vapor tool. A vac truck was emptied into the volume between vapor tools to give them some separation. The product that was removed during the purge was re-injected moving the DS vapor tool back through the new pipe until the air was all removed.

The LOTO was then removed from both IsoTools and the internal bypasses were opened to equalize the pressures across them. Both IsoTools were UNSET simultaneously. Operations were returned to Pipeline Control and Integral Trackers followed the tools to trap. Due to the length of the IsoTools and the presence of the vapor tools, the pigs needed to be trapped separately. The line was slowed as the pigs approached the trap and flow halted when the DS IsoTool was in the barrel. After it was pulled, the line re-started and the 2 vapor tools and the US IsoTool were trapped together.

COST SAVINGS

Integral has aggressively priced the IsoTools to be competitive with purging and full bore split tees.

On small diameter pipelines it is challenging to compete with nitrogen, since the volumes needed are often the most reasonable option. Line stops can be an effective choice if flow must be maintained throughout the tie in, or if there is a flow restriction (such as a stuck pig, or large dent) but such fittings can be expensive and have the potential to cause future integrity concerns.

It is difficult to compare such radically different methods since impact on the delivery schedule of the pipeline can trump other costs. This project would have required 2 split tee hot taps and it is conservatively estimated that utilizing the IsoTools and a short purge reflects a 25-50% cost savings. If a regular valve-to-valve purge had been employed the length of displacement would have been 35 miles. Nitrogen purge pricing also has the potential to fluctuate greatly based on pressures and location, but the cost of the outages required can be incalculable.

CONCLUSION

Utilizing isolation tool technologies in conjunction with nitrogen purging is an exciting new application that has potential to greatly reduce the length of purge sections. The IsoPurge can be deployed as it was in the case study, or also by using an existing valve and a single tool application. An IsoTool could be parked DS of a valve and propelled using nitrogen to a proposed set location, or also utilized to greatly minimize a conventional drain up.

The benefits of the IsoPurge are numerous:

- Pipeline operators can now choose the initial and terminal points of a nitrogen purge.
- When split tee fittings are used there is still the necessary task of removing the oil from the abandoned pipe. With the IsoPurge the oil is displaced and the line is left empty.
- No large fittings are left on the pipeline, just some small taps are required for gas injection and product discharge.
- Decreases pipeline down time needed for a longer purge.
- No welding on a live pipeline as would be required by full bore fittings.
- Cost savings.

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