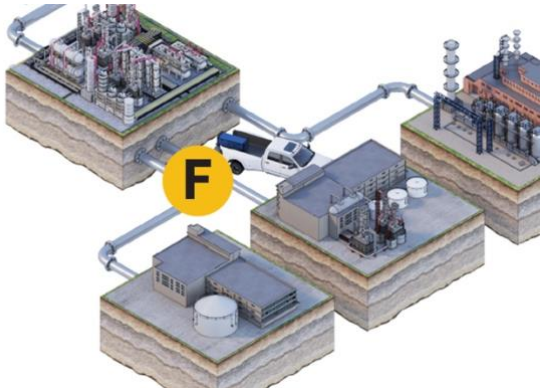
Section 8:
ZEVAC® for Integrity Management - Pigging



Problem Description

On a transmission system, pigging is a routine occurrence. Pigging can be performed for any number of reasons and is one of the most common activities performed by gas transmission divisions. There are many reasons to perform a pigging run. Pigging can be done to perform routine maintenance to ensure nothing has happened to the integrity of the pipe. This process is often referred to as an ILI pigging run or In Line Inspection.

This activity serves as preventative maintenance to ensure that there is nothing present in or obstructing the inside of the pipe. Additionally, it can also be considered another type of preventative maintenance by using a cleaning pig that effectively removes any deposits or debris from the pipe walls.

Pigging operations have various applications, and accordingly, there is a wide range of pigging tools available to accommodate the complexity of each project. While there are numerous types of pigging operations, one common aspect across all of them is the need for venting/flaring. To launch the pig from the pressurized launcher site, the pipeline must be opened to the atmosphere, obviously leading to venting/flaring. After the launcher has been opened to the atmosphere, the pig is inserted and the section of pipe behind it is pressurized again to create a pressure differential.

This pressure differential ensures the pig is pushed through the pipe and depending on the procedure being performed, the pig will either clean, show deformations in the pipe, or inspect the integrity of the pipe. Once the pig has traveled throughout the pipe, the receiver site will have to be depressurized to open the receiver hatch and remove the pig. As can be observed in a standard pigging procedure, a standard pigging operation involves venting not once, but twice when the pig is launched and received.

ZEVAC provides a solution for both of these instances of harmful venting. Instead of venting at the launcher and receiver sites, the venting that occurs at these sites can be prevented by vacuuming out the gas via the use of a ZEVAC unit and discharging into another "live" section of pipe. Pigging runs are one of the most frequent activities for gas distribution services and these high-volume, frequent occurrences is where the use and deployment of ZEVAC can make the biggest impact.

Illustrated Checklist and Diagram – Portable Install

Prior to using a ZEVAC system, it is important to identify the procedural steps needed in order to have a successful drawdown of the launcher or receiver site. These major procedural steps include:

1. Recognize and understand Maximum Allowable Pressure (MAOP) of the pipeline.
2. Identification of isolation valves for intake and discharge points.
3. Close valves to isolate launcher/receiver barrel to be depressurized.
4. Connect the ZEVAC unit to the launcher/receiver connections using flex hose and appropriate fittings as well as the air compressor. Ensure the whip checks are in place and open the isolation valves. Purge air from the ZEVAC hoses and equipment before starting actual recompression.

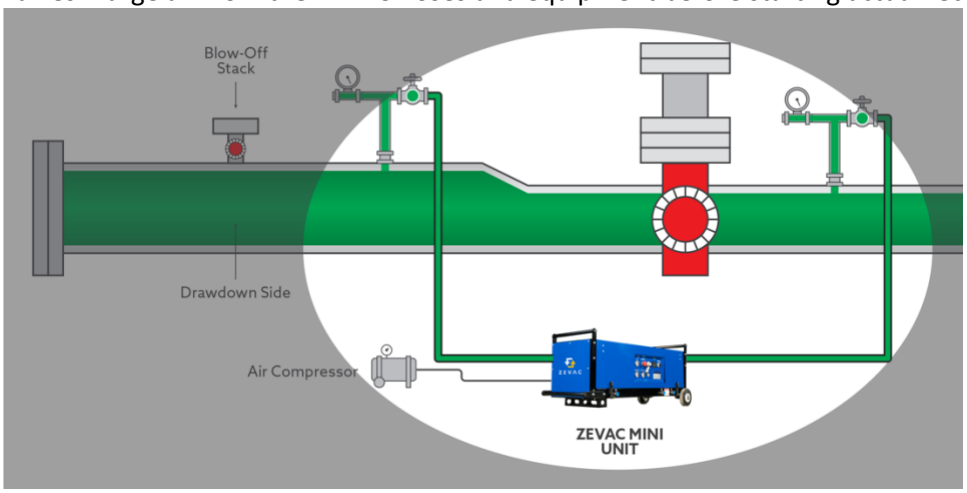


Figure 49: *Diagram of pigging drawdown (Image 1 of 4)*

4. Record starting pressure of the launcher/receiver barrel and the discharge portion of pipe.

5. Turn on the ZEVAC unit and air compressor to begin drawdown.
6. Monitor pressure at the discharge point and intake section to ensure that discharge does not cause over-pressurization of the discharge side pipe system and that intake does not go below desired pressure. **Note:** The Under Pressure Cut Off Switch (UPCO) and Over Pressure Cut Off Switch (OPCO) are designed to ensure the unit shuts off before reaching MAOP or desired draw down pressure.

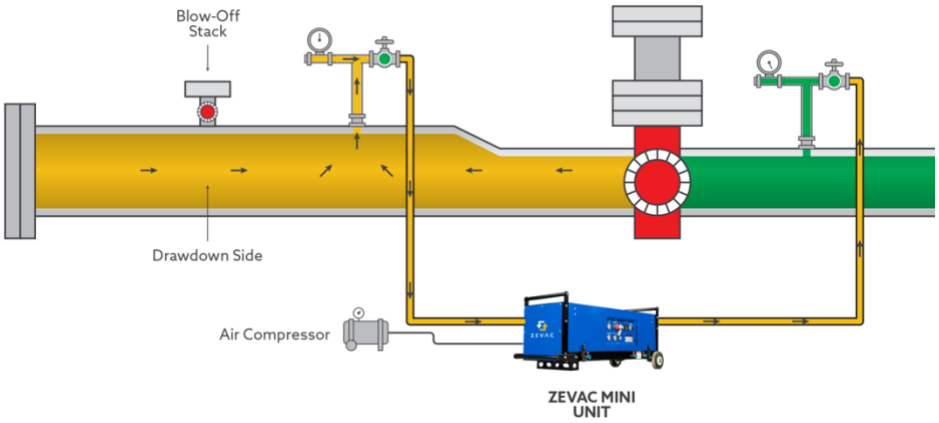


Figure 50: *Diagram of pigging drawdown (Image 2 of 4)*

7. Once desired pressure is reached, stop the ZEVAC unit and air compressor.
8. Record final pressure readings in intake section and discharge section of the pipe.

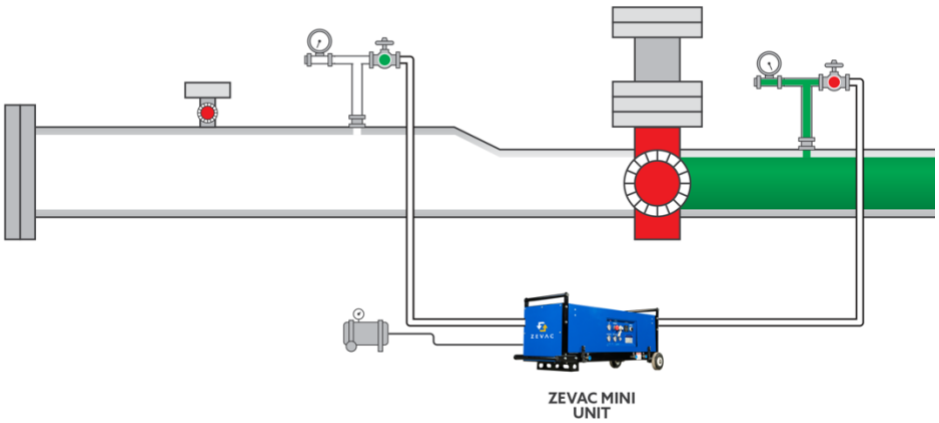


Figure 51: *Diagram of pigging drawdown (Image 3 of 4)*

9. Close the isolation valves, depressurize, and disconnect ZEVAC and air compressor equipment.
10. Insert or remove pig from the barrel.

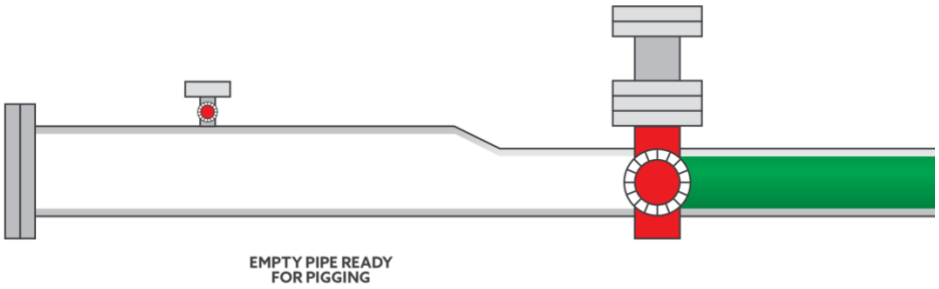
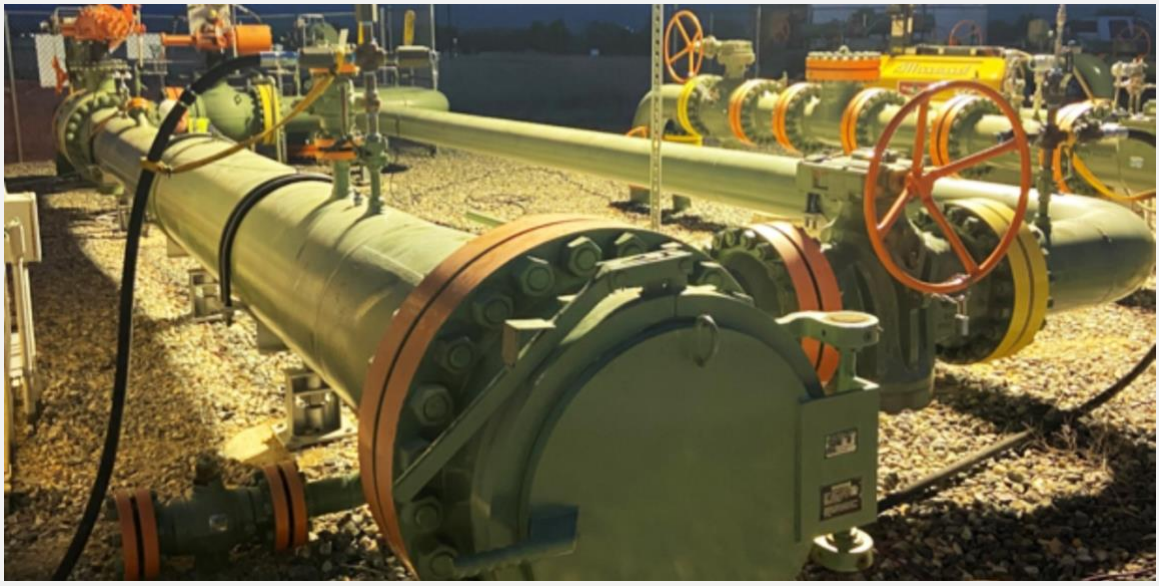


Figure 52: *Diagram of pigging drawdown (Image 4 of 4)*

Case Study: Integrity Management - Pigging

About the Project	
Who	Xcel Energy
What	Depressurization of seven different launchers and receivers
Why	Reduce emissions and prevent purging a large volume of gas
Where	Fort Lupton, CO
When	June 2022



CEPC (Campos EPC) was contracted by Xcel Energy to use ZEVAC with the assistance of a ZEVAC operator, along with EN Engineering, TD Williamson and a MEARs crew, to perform the drawdown on what was meant to be 3 launchers and 3 receivers, but ended up being 4 launchers and 3 receivers. The additional launcher drawdown was necessary due to concerns expressed by Xcel Energy on the first day regarding flow and timing. After the first drawdown, work was halted, the launcher was repressurized, and the crew returned the following day. These projects were not in high-traffic urban areas but were still close to residential neighborhoods and would have required notifications of the venting/flaring activity and expected complaints due to the noise the venting/flaring would have caused. By using ZEVAC, venting/flaring for this project was entirely avoided, eliminating any public nuisances and greatly reducing emissions for this frequently required pigging procedure.

The launchers and receivers for this project were depressurized using two ZEVAC Quad M Gen 4s and two rented air compressors.

For this project, the location of compressors and the ZEVAC unit were identified and confirmed with Xcel Energy. The placement of the ZEVAC unit was intentional to allow for ease of use and to provide a clear path for exit in case of an emergency. ZEVAC hoses were connected after they had identified the relevant drawdown and discharge isolation valves and removed the plugs. Following removal of the plugs, the TPE operator installed “Valve Trees” to each valve.

Once the site was set up, the compressors were turned on to start a warmup cycle. Once adequate pressure was built, ZEVAC operations began at 5:19 am. Initial drawdown pressure was 690 psig and initial discharge pressure was 712 psig. The operation proceeded without incident and concluded at 6:11 am. The final drawdown pressure was 0.3 psig while final discharge pressure was 720 psig.

After depressurization, pressure gauges were removed from the launcher and the pig was loaded. The pig was manually pushed down the barrel by MEARS crew until it was at an agreed upon depth. The launcher door was then closed and sealed. The line was repressurized and the tool began to move through the line. Once the tool had left the launcher location, equipment was packed and all crews left for the receiver site.

Upon the pig’s arrival at the receiver site, the ZEVAC units were set up in the same manner as the launcher site. ZEVAC operations began at 10:03 am. Initial Drawdown pressure was 712 psig and initial discharge pressure was 882 psig. The operation proceeded without incident and concluded at 10:46 am. The final drawdown pressure was 0 psig while final discharge pressure was 720 psig.

Following confirmation of depressurization, the receiver door was opened and the cleaning pig was pulled from the barrel. Initial inspection revealed the tool was clean enough to proceed with a deformation pig the following day.

The following day, ZEVAC units were set up in the same orientation as the day before. ZEVAC operations began at 5:12 am. Initial Drawdown pressure was 597 psig and initial discharge pressure was 713.4 psig. The operation proceeded without incident and concluded at 5:56 am. The final drawdown pressure was 0 psig while final discharge pressure was 710.1 psig.

Following depressurization, pressure gauges were removed from the launcher and the pig was loaded. A tow line was attached to an eye bolt at the end of the pig and drawn through an open valve on the line. This was pulled using a large telescopic forklift until it was at a satisfactory distance in the launchers barrel. The open tow line valve was then sealed. The line was repressurized and the tool began to move through the line. Once the tool had left the launcher location, equipment was packed and all crews left for the receiver site.

Upon the pig's arrival at the receiver site, the ZEVAC units were set up in the same manner as the launcher site. ZEVAC operations began at 10:30 am. Initial Drawdown pressure was 664.5 psig and initial discharge pressure was 717.4 psig. The operation proceeded without incident and concluded at 11:13 am. The final drawdown pressure was 0 psig while final discharge pressure was 730 psig.

Following confirmation of depressurization, the receiver door was opened, and the deformation tool was pulled from the barrel. The tool was moved to an area separate from the launcher and cleaned by MEARs. Initial inspection revealed only minor deformations, greenlighting the ILI tool run the following day.

Four days later, ZEVAC units were set up in the same orientation as previously done. ZEVAC operations began at 5:39 am. Initial Drawdown pressure was 695.6 psig and initial discharge pressure was 711.6 psig. The operation proceeded without incident and concluded at 6:28 am. Final drawdown pressure was 0 psig while final discharge pressure was 710.7 psig.

Following depressurization, pressure gauges were removed from the launcher, and the pig was loaded. A tow line was attached to an eye bolt at the end of the pig and drawn through an open valve on the line. This was pulled using a large telescopic forklift until it was at a satisfactory distance in the launchers barrel. The open tow line valve was then sealed. The line was repressurized and the tool began to move through the line. Once the tool had left the launcher location, equipment was packed, and all crews left for the receiver site.

Upon the pig's arrival at the receiver site, the ZEVAC units were set up in the same manner as the launcher site. ZEVAC operations began at 10:12 am. Initial Drawdown pressure was 672.8 psig and initial discharge pressure was 705.7 psig. The operation proceeded without incident and concluded at 11:06 am. The final drawdown pressure was 0 psig while final discharge pressure was 717 psig.

Following confirmation of depressurization, the receiver door was opened and the ILI tool was pulled from the barrel. The tool was moved to an area separate from the launcher and cleaned by MEARs. Tool data was then collected by TD Williamson.

Other than the initial delay mentioned, there were no significant delays when performing this project. All 7 drawdowns were able to be executed flawlessly and ZEVAC succeeded in completely depressurizing all launchers and receivers while performing this pigging operation.

Figure 53: *Cleaning "Pig" before and after operation*

Figure 54: *Deformation "Pig" before and after operation*

Figure 55: *ILI "Pig" before and after operation*

Figure 56: *ZEVAC drawdown setup at launcher*

Figure 57: *ZEVAC drawdown setup at receiver*

Figure 58: *One of the air compressors used for this project*

Results, Conclusions, and Lessons Learned

This project, ILI Pigging Project Ft Lupton to CIG, was the complete depressurization 7 different times of a launcher and receiver sites combined. This project ran seamlessly. Other than the initial delay, at no fault to ZEVAC, there were no challenges. Since this project ran smoothly, it is difficult to pinpoint something needing improved upon or any improvements in our methodology. The steps taken by this project to ensure a seamless pigging operation should be noted and followed in addition to being meticulous with the pigging procedure. It's important the equipment used during these projects is reliable and a proper procedure is outlined when closing and opening valves for these types of projects.

The ZEVAC impact from the Xcel Energy project:

18.1 Metric Tons CO2e Saved	**31,803** SCF Natural Gas Not Vented	**46,311** Miles Not Driven
	20,236 Pounds of Coal Not Burned	**6.3** Tons of Waste Recycled Instead of Landfilled
	21.5 Acres of Forest Grown for One Year	**299** Seedlings Grown for 10 Years

Considerations

When setting up a pigging project for ZEVAC there are several items that must be considered:

- Move all customers and service lines onto new HDPE supply.
- Isolate receiver and launcher stations.
- Identify a suitable discharge injection point.
- Connect ZEVAC to drawdown gas from either launcher or receiver and discharge into “live” system.
- Proceed with depressurization of launcher or receiver site.
- Proceed with final pigging procedure once launcher or receiver is at or near 0.0 psig.

Additional steps that may aid in project planning and execution include:

- Understanding the maximum allowable operating pressure (MAOP) and flow of a pipeline is crucial for safe and efficient operation, requiring ongoing monitoring and management.
- Analyzing redirection of gas in the system.
- Determining gas flow rates, pressure and system volumes so proper calculations can be made and correct equipment can be specified.
- Identifying additional locations where ZEVAC may be hooked up and use multiple units along pipeline section or in series/parallel to minimize drawdown times.

Additional challenges to be considered prior to mobilizing ZEVAC for depressurizing a system for a pigging project are as follows:

- Labor Costs
- Equipment Rental/Lease/Purchase
- Installing Fittings to Connect Equipment
- Need for Installation of a Filter Separator or Drainage
- Logistic Constraints
- Introduction of New Technology
- Regulation Changes
- Location
- Pipeline Length & Diameter
- Ease of Use
- Reliability
- Duration
- Clean Up
- Control of Pressure & Volume

While each of these requires individual consideration, the utilization of ZEVAC has been proven to minimize the quantity and extent of these challenges. When ZEVAC is used as a proper solution to venting and flaring, many of these challenges are reduced to small concerns