Part 1:

ZEVAC® for Distribution Systems

Natural gas Local Distribution Companies (LDCs) have unique challenges that are different from other parts of the natural gas supply chain, a number of these challenges include:

- Urban Environments
- Traffic
- Odorized Gas
- Public Visibility
- Weather Dependent Flow Conditions
- Unionized Workforce
- Long Budget Cycles
- Public Utility Commission Approvals
- Overpressure Protection Critical
- Old Infrastructure
- Aggressive Environmental, Social, & Governance (ESG) Ambitions

In these sections, we will show how distribution operators use the ZEVAC to work around the challenges described above to perform the following activities without venting gas:

- **Section 1: Main Replacements** – Large-scale planned operations where old (usually cast iron and bare steel) pipe is replaced with modern piping (coated steel or HDPE) systems. Traditionally, the old main would be vented prior to retirement.
- **Section 2: Commissioning New Lines (Ventless Purging)** – Newly laid distribution piping is traditionally "purged into service" by blowing gas through the lines and venting a gas + air mixture until a suitable gas purity is achieved.
- **Section 3: Meters & Regulators** – Small systems such as meters and regulators have frequent maintenance requirements such as calibration, repair, and replacement that require the equipment to be depressurized prior to the work being performed.
- **Section 4: Odorization** – Odorization equipment poses unique challenges related to the saturation of mercaptan that frequently results in "leak" calls if any venting occurs.
- **Section 5: Main Repairs** – When valve replacements, tie-ins, or cutouts are required, venting has been part of the traditional standard procedures.

The following sections will show examples of how operators across the United States utilize ZEVAC equipment to achieve compliance with their net-zero commitments and evolving state and federal regulations. This manual will provide guidance to the various applications where the ZEVAC can support operators and their unique challenges.

Section 1:
ZEVAC® for Main Replacement Projects

Problem Description

Main replacement projects consist of isolating a section of the pipeline to allow the line to be abandoned and replaced. The isolation process usually involves the closing of valves, pressure control fittings (PCFs), and other traditional pipeline isolation devices. During the isolation process, natural gas trapped in the intermediate pipe has been historically vented into the atmosphere.

When utilizing the ZEVAC, all the trapped gas is transferred from the isolated section of pipeline that is being replaced/abandoned back into a pressurized section of the pipeline behind an isolation or a valve, or into an adjacent pipeline if one is available. This process reduces the volume of gas lost into the atmosphere due to venting and immediately reduces emissions.

Figure 3: *Urban environment main replacement*

Main replacement projects are often conducted in highly populated regions within the public view. Flaring and gas blowdown tends to be visible from the surrounding community and draws attention to the project. In populated areas, it is important to minimize attention to the project for both the public and workers' safety.

Illustrated Checklist and Diagram

Prior to using the ZEVAC equipment, it is important to identify the procedural steps for a successful installation. These major procedural steps include:

1. Recognizing and understanding Maximum Allowable Operating Pressure (MAOP) of pipeline and flow of gas. Example: Looped systems or dead-end systems.
2. Identification and possible installation of taps for extraction and injection points.
3. Utilize stopple or close valves to stop the flow into the portion of the pipe to be depressurized.
4. Connect the ZEVAC unit to the installed taps using flex hoses and appropriate fittings. Then, connect the ZEVAC unit to the air compressor with the air hose. Ensure the whip checks are in place and open the tap valves. Purge air from the ZEVAC hoses and equipment before starting actual recompression.

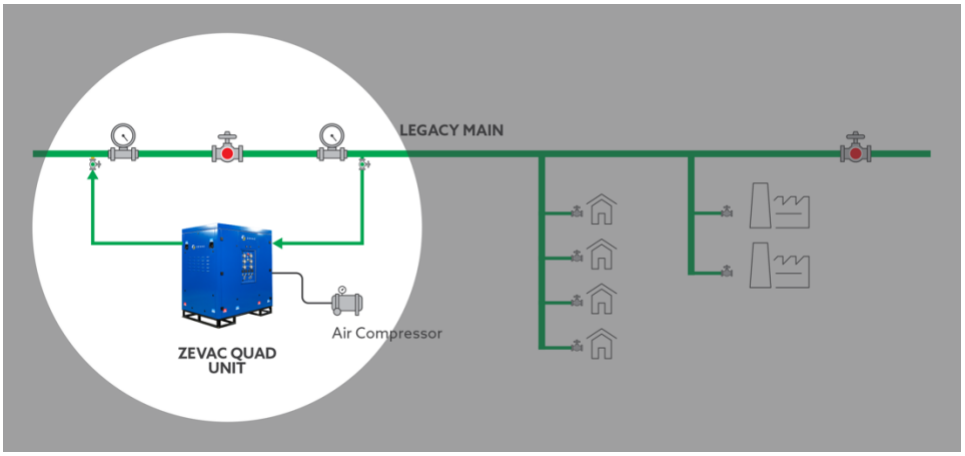

Figure 4: *Diagram of main replacement drawdown (Image 1 of 4)*

5. Record starting pressure of both the injection portion of the pipe and the depressurized segment.
6. Turn on the ZEVAC unit. Then turn on the air compressor to begin drawdown.

7. Monitor pressure at the injection point and drawdown section to ensure injection does not cause over-pressurization of the injection side pipe system and drawdown does not go below the 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.

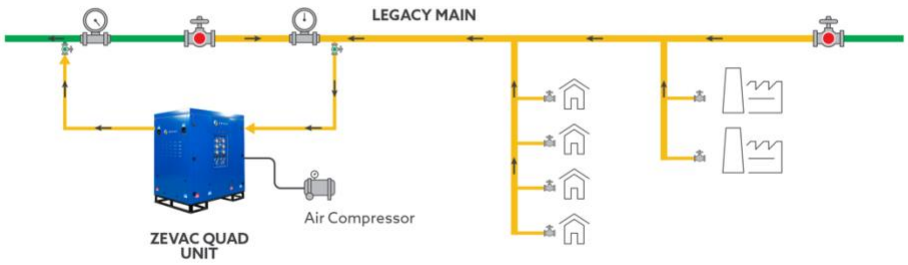

Figure 5: *Diagram of main replacement drawdown (Image 2 of 4)*

8. Once the desired pressure is reached, stop the ZEVAC equipment and the air compressor.
9. Record the final pressure readings in the drawdown section and active section of the pipe.

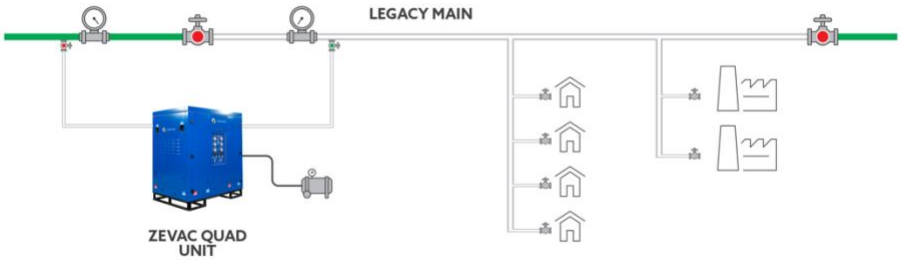

Figure 6: *Diagram of main replacement drawdown (Image 3 of 4)*

10. Close tap valves and disconnect ZEVAC and air compressor equipment.
11. Replace pipeline main.

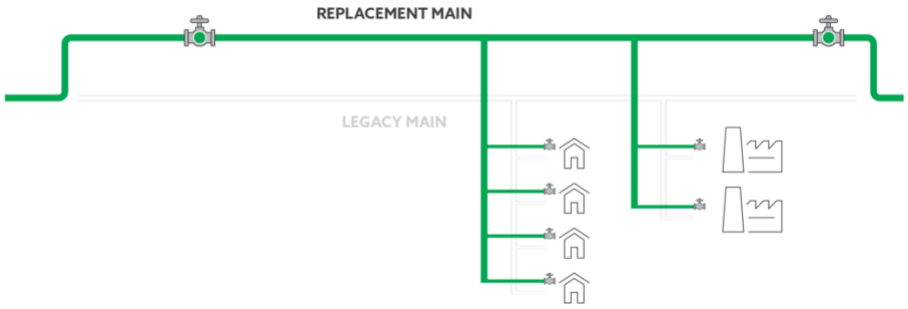

Figure 7: *Diagram of main replacement drawdown (Image 4 of 4)*

Case Study: Main Replacement

About the Project	
Who	Consolidated Edison, Inc.
What	3,000' section of natural gas main
Why	Transfer natural gas from cast-iron and steel main for replacement with plastic piping
Where	Utopia Parkway, Queens NY
When	November 2022

Con Edison was the first gas distribution company in the United States to use ZEVAC technology on live gas mains. Con Edison's Research and Development group provided ZEVAC with input on the needs of a typical gas distribution company. ***"This equipment fits perfectly with our belief that Con Edison has a unique opportunity to play a leadership role in reducing emissions and fighting climate change, as we pledge to do in our Clean Energy Commitment,"*** said Nicholas Inga, Con Edison's vice president, Gas Operations. ***"Our long-term goal is to move away from fossil fuels and transition to renewables, but in the interim this equipment allows us to reduce the release of methane as we fulfill our obligation to provide safe, reliable service to our customers."***

The machine has another benefit. The release of natural gas into the atmosphere often prompts residents and businesses in the area to call in a suspected gas leak. The situation leads to an avoidable response from the local fire department, resulting in dispatching crews to investigate odor complaints, which adds additional costs to the projects operations.

According to the U.S. Environmental Protection Agency, methane has 25-times as much global warming potential as carbon dioxide (on a pound-for-pound basis) and methane concentrations in the atmosphere have more than doubled in the last two centuries (mainly due to human-related activities).

Figure 8: *Crews working with ZEVAC*

A Con Edison gas crew on Utopia Parkway in Queens NY, transferred natural gas from a 3,000-foot section of main. That gas contained the amount of greenhouse gas emissions the average passenger car would emit during 11,250 miles of travel. Using the ZEVAC on that job avoided the amount of carbon emissions produced by burning 510 gallons of gasoline or 10.5 gallons of oil.

Con Edison's aggressive program to replace cast-iron and unprotected steel gas main with plastic piping, which is more durable and less vulnerable to leaks, provides plenty of opportunity to use the ZEVAC machine. The company has been replacing an average of 90 miles of gas main a year as part of its effort to keep its gas system safe and reliable during the transition from fossil fuels to renewables. The company makes clear in is Clean Energy Commitment that it will reduce its use of fossil fuel natural gas as it explores new ways to use its gas delivery system to serve customers.

Results, Conclusions, and Lessons Learned

Utilizing the ZEVAC can reduce the time and costs associated with main replacement projects by:

- Reducing delays for special equipment, permits, and crews.
- Removing the obstacle. A large flare is often not an option because of its location and distance required for facility safety.
- Avoiding the noise from flaring/venting.
- Resulting in zero product loss.
- Releasing zero emissions.
- Reducing overall job time and expense.
- Preserving community and worker safety.

Employees and residents are put in danger when venting/flaring gas by inhaling toxic gases, exposure to high-decibel noise, and creating a highly explosive and flammable environment during flaring/venting.

By using the ZEVAC technology, projects can be executed sooner, require no permits, and eliminate the need for extra labor and planning typically used to make venting/flaring safe. Flaring/venting large volumes of gas at low pressure can take a long time. By using the ZEVAC technology, gas can be moved faster by pushing it to the service pipe at the needed pressure, accelerating the work schedule.

Considerations

When setting up a main replacement project utilizing the ZEVAC, there are several considerations to make:

- Move all customers and service lines onto new HDPE supply.
- Isolate legacy main.
- Identify suitable discharge injection point.
- Connect the ZEVAC to drawdown gas from legacy main and discharge into new “live” system.
- Proceed with depressurization of legacy main.
- Proceed with the final abandonment procedure once legacy main is at or near 0.0 psig.

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

- Analyzing redirection of gas in the system.
- Identify locations where stopples can be placed to reduce length of pipeline to be drawn down.
- Determining gas flow rates, pressure, and system volumes so proper calculations can be made, and correct equipment can be specified.
- Conduct work during non-peak flow timeframes.
- Identify additional locations where the ZEVAC may be hooked up and use multiple units along a pipeline section or in series/parallel to minimize drawdown times.
- Drawdown segment using regulators.

Challenges to consider prior to mobilizing the ZEVAC for depressurizing a system for a main replacement are:

- 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 and diameter
- Ease of use
- Reliability
- Duration
- Clean up
- Control of pressure & volume

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