



***A Publication for AGA Members***

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# **Blowdown Emission Reduction White Paper**

**Authored by the Joint Blowdown Emission Reduction Taskforce of the  
AGA Environmental Matters Committee and  
AGA Engineering Committee**

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# **Blowdown Emission Reduction**

## **White Paper**

### **INTRODUCTION**

The increased use of natural gas, especially for electricity generation, continues to help reduce carbon dioxide emissions. However, as production and consumption of natural gas increases, more concern and attention are being given to reducing methane emissions from all parts of the natural gas value chain, including from blowing down gas from pipelines and equipment to make it safe for repairs and other work to proceed. The following introduction provides (1) context for the white paper to explain why it is important to consider how and when to take steps to reduce methane emissions from blowdowns, and (2) an overview of the white paper.

#### **Context**

Natural gas is mainly composed of methane. Pipeline quality natural gas delivered to customers typically contains 95 percent or more methane, with less than 5 percent liquid hydrocarbons and trace constituents. Methane (CH<sub>4</sub>) contains only one carbon atom for every four hydrogen atoms – far less carbon than other fossil fuels. As a result, combusting natural gas emits far less carbon dioxide (CO<sub>2</sub>), a greenhouse gas (GHG). For example, switching from coal to natural gas to generate electricity reduces

greenhouse gases by an average of 53 percent.<sup>1</sup> Increased use of natural gas is the single largest factor in power sector emissions reductions. Natural gas efficiency and the growth of renewable energy combined have led to energy-related carbon dioxide emissions hitting 25-year lows.<sup>2</sup>

Methane is considered to have a higher heat-trapping ability than CO<sub>2</sub> in the short term, but methane lasts only 12 years in the atmosphere, whereas CO<sub>2</sub> can last for hundreds of years before breaking down.<sup>3</sup> The vast majority of GHG emissions in the U.S. and worldwide comes from CO<sub>2</sub>, so that is the main focus for reducing climate impacts. However, there is also interest in seeking ways to reduce methane emissions because these reductions could have near term benefits.

It is important both to reduce methane emissions *and* to measure and estimate those emissions more accurately, because some in the public policy realm have questioned the value of natural gas by questioning the extent to which the climate benefits of lower CO<sub>2</sub> emissions from using natural gas may be offset by emissions of methane from non-hazardous low volume leaks or venting (including blowdowns) from pipelines or equipment used to produce and transport natural gas to customers -- from production well to burner tip. Many peer-reviewed scientific studies have evaluated this question over the past decade. In 2012, an influential paper by a scientist at the Environmental Defense Fund (EDF), asserted that using natural gas in place of other fossil fuels would have immediate climate benefits if methane emissions across the natural gas supply equal no more than 3.2 percent of annual production for switching electric generation from coal to natural gas, 1.7 percent for switching cars and light duty vehicles from gasoline to compressed natural gas (CNG), and 1 percent for switching heavy duty vehicles such as

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<sup>1</sup> See pages 16- 17 of the 2020 AGA Playbook, shown online as pages 18-19 <http://playbook.aga.org/>, based on data from the U.S. Department of Energy (DOE) Energy Information Administration (EIA) and the April 2019 U.S. EPA GHG Inventory (1990-2017).

<sup>2</sup> Id.

<sup>3</sup> The Global Warming Potential (GWP) of methane compared to CO<sub>2</sub> is calculated to be about 25 times CO<sub>2</sub> over a one hundred-year period, or 80-85 times compared over a shorter term 20-year period. IPCC Fourth Assessment Report, UN Framework Convention on Climate Change (UNFCCC), [www.unfccc.int](http://www.unfccc.int).

large trucks from diesel to CNG.<sup>4</sup> Whether or not one agrees with the methodology employed and assumptions made in the study, this has become a baseline for the methane debate. Fortunately, EPA's annual Inventory of U.S. Greenhouse Gas Emissions and Sinks shows that average national methane emissions across the natural gas supply chain are just 1 percent of annual production and declining.<sup>5</sup> This is already low enough to demonstrate *immediate* climate benefits for switching to natural gas for nearly all energy needs.<sup>6</sup> This white paper illustrates and evaluates methods that can be considered in an effort to reduce emissions further.

The need to implement every practice and the timing of any implementation of the practices described in this document will vary with each operator based upon the specific environment in which they operate. The actions within this document should be evaluated by considering each operator's system, geographic variables, the operator's independent integrity assessment, risk analysis, and mitigation strategy as well as what has been deemed reasonable and prudent by their state regulators. Therefore, not all the practices described in this document will be applicable to all operators. As used herein, the term "should" is not mandatory but is to be acted upon as appropriate.

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<sup>4</sup> See Alvarez et al, "Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure," PNAS April 24, 2012 109 (17) 6435-6440.

<sup>5</sup> AGA Analysis of U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2018) published April 2020, <https://www.aga.org/research/reports/epa-updates-to-inventory-ghg/>.

<sup>6</sup> Id. Note that some have argued based on top-down aircraft studies of atmospheric methane concentrations that emissions may be 60 percent or more higher than EPA's Inventory estimates, but a 2018 National Academies of Science (NAS) consensus study report determined that this type of top-down study can over-estimate emissions and that the best practice for reconciling bottom-up equipment and facility measurements underlying the EPA Inventory with top down atmospheric measurements is to have site access to conduct both types of measurements in the same place in the same time frame to reduce or eliminate time and spacial variables. See Improving the Characterization of Anthropogenic Methane Emissions in the United States, NAS 2018, available at <https://www.nap.edu/catalog/24987/improving-characterization-of-anthropogenic-methane-emissions-in-the-united-states>. The consensus gold standard methodology described in the NAS Report was used in the ground-breaking 2018 Basin Methane Reconciliation Study, funded by the U.S. DOE. See the peer-reviewed capstone paper published in the Proceedings of the National Academies of Science (PNAS) in 2018. Vaughn TL, Bell CS, Pickering CK, Schwietzke S, Heath GA, Pétron G, Zimmerle D, Schnell RC, Nummedal D. , "Temporal Variability Largely Explains Difference in Top-down and Bottom-up Estimates of Methane Emissions from a Natural Gas Production Region," *Proc Natl Acad Sci. Oct. 29, 2018*. Links to related methodology papers, a [short readable summary](#), and an excellent [short explainer video](#) are available on the Colorado State University (CSU) [Basin Methane Reconciliation study web page](#).

## Overview

Methane emissions result from a variety of sources and processes throughout the natural gas system, but this paper is focused primarily on blowdowns from pipelines in transmission, storage, gathering and distribution systems. Where relevant, the paper also addresses blowdowns of compressors.

The purpose of this paper is to establish a general understanding of the operational and regulatory drivers, procedures and constraints related to blowdown activities and to explore some common and emerging opportunities for mitigating emissions. The white paper will also discuss existing regulatory frameworks for reporting blowdown activities and emissions.

While blowdowns are a normal part of operations, the incentive to minimize emissions or to eliminate blowdowns has never been greater. Although natural gas is a clean-burning fuel, environmental groups, investors, policy makers and other stakeholders expect companies to reduce the amount of un-combusted methane released to the atmosphere. Blowdowns, whether for maintenance, during normal operations, or in an unplanned event, can be a source of methane emissions.

A natural gas blowdown is the act of emptying or depressurizing natural gas from the equipment designed to contain it for the purpose of maintenance, testing or other activities such as installing new pipeline. Blowdowns are necessary so work can safely take place. Blowdowns have historically been viewed as a normal operation. In the past, there was some interest in reducing the volume of odorized gas vented in a blowdown in order to reduce odor calls, but more recently, interest has grown in how to reduce methane emissions from blowdowns in order to improve environmental outcomes. As a result of this interest, operators have developed a variety of options for reducing methane emissions. A high-level review of associated methods, applications, and procedures and

mitigation methods to eliminate or reduce blowdown emissions can be found within the subsections of this paper.

Intentional gas venting activities fall under two categories, planned and unplanned. Planned events are events where equipment outages are scheduled in advance. Planned events can be equipment or pipe replacement, retirement, pigging (i.e. using a robotic inline inspection tool or “ILI”), testing, compliance related inspections or normal maintenance activities. Unplanned events are those occasions where an equipment or system problem dictates the necessity to blowdown. Unplanned events generally have pressing return-to-service timelines. Although both venting activities pose potential for sequestering the venting gas, planned events afford the greatest opportunity.

Note that blowdowns of transmission and storage *compressors* that occur based on changes in demand in the pipeline are known but not preplanned. However, they may also offer opportunities to reduce emissions.

It should also be noted that in some situations, taking steps to avoid or reduce a blowdown may not be warranted for purposes of reducing methane emissions if the alternative would result in even more greenhouse gas emissions. In planning, a company may wish to consider whether increased carbon dioxide (CO<sub>2</sub>) from sources that would be deployed to capture or reduce a blowdown - such as increased emissions from temporary compressors or other equipment - could outweigh the emissions reduction anticipated from reducing the blowdown.

When proposing to develop an emissions-minimizing blowdown plan, the following personnel and departments may be potential stakeholders in the decision-making process— engineering, operations, gas control, environmental, measurement, sustainability, legal, and public affairs. The suggested best management practices may vary depending on the specific equipment and situation. A discussion of pros or cons associated with each procedure has been collected for consideration.



This introduction has explained why blowdowns – and emission reductions – are needed. The following chapters will address questions about who should be involved, how to avoid blowdowns if possible and if warranted, how to reduce emissions if a blowdown is required, what technologies and methods are available, and what can get in the way.

## **CHAPTER 1**

### **BLOWDOWN ROLES AND RESPONSIBILITIES**

Several departments and teams within a natural gas utility or pipeline may have a role to play in planning, coordinating and executing a successful blowdown. This chapter outlines the skill sets needed and the general roles and responsibilities for the different departments or teams, depending on whether a blowdown is pre-planned, part of routine operations and maintenance (O&M) work, or associated with emergency work. In addition, we note which groups may have a role in communicating or coordinating with others – such as other teams within the company, contractors, first responders, neighbors, regulators or the general public.

Blowdowns are normally required for the following:

- Projects involved with replacing, retiring, or modifying gas-containing equipment. The blowdown activities are always preplanned.
- Compliance O&M activities such as pigging, hydro testing and station equipment overhaul. The blowdown activities are always preplanned.
- Unplanned events where equipment or systems are taken out of service due to problems, malfunctions, or abnormalities.

While companies will vary in their organization and procedures, and the options that are feasible for gas distribution, transmission and storage may differ, the following identifies the types of departments (or functional areas) that are typically involved in blowdown activities and describes their typical roles and tasks.

## **A. Operations**

The operations department (Operations) of a company operating natural gas transmission, storage, gathering or distribution facilities will typically be responsible for initiating and planning projects that require blowdowns. In most companies, Operations, working with Gas Control, will have primary responsibility for developing, approving and implementing all blowdown procedures and for contacting the Engineering Department for “clearance” to work on a specific section of the pipeline or facilities. In some companies, Engineering may take the lead, coordinating with Operations. Regardless of which department initiates projects, it is important to ensure that both the Engineering and Operations departments are in communication. Operations would also need to contact the Gas Control group for assistance in determining where to send the natural gas to be re-routed (in order to minimize service disruptions and to minimize blowdown volumes). Operations would usually be responsible for “capturing” data that is needed to calculate or estimate the amount of blowdown emissions and/or the amount of emissions reduced or avoided, but Engineering would typically perform the calculations. Such data would include, for example, pipe diameter, length and pressure, used to calculate the volume contained in the equipment or pipe. Operations would also report the measures used to reduce blowdown emissions, so that Engineering can calculate what portion of that volume was emitted or not emitted.

Capital projects and most O&M work are generally planned in advance and can be run by either Operations, Engineering or another group. Regardless of the group executing the work, notification to neighbors and first responders about the type of work and any blowdowns activities should be made. The responsible group will be required to isolate, blowdown and lock and tag out the equipment.

Operations may also request that a reverse 911 message be sent to landowners in the township where a blowdown will take place.

For emergency situations, Operations would take direct responsibility for initiating execution and field coordination of required blowdown procedures. Specific tasks could include performing lock-out/tag-out, monitoring gas pressure and blowdown time during the operation, and purging and loading operation. In emergency situations, Operations would have a role in both internal company communications (with Gas Control, Engineering, Legal, Public Affairs, and other departments pursuant to the company's procedures) and external communications with contractors and first responders. Other external communications with neighbors, the public, and government entities would likely be managed by Public Affairs, working with the Legal Department, when appropriate.

## **B. Engineering**

The Operations department should contact the engineering department for information on approved pipeline safety blowdown/purging procedures. Purging involves removing gas or air from the pipeline, often with the use of an inert gas such as nitrogen.<sup>7</sup> It can be helpful for Engineering and Operations to coordinate with the environmental department (Environment) in developing company blowdown/purging standard operating procedures in order to incorporate guidance on when and how to consider using techniques for avoiding a blowdown or for reducing emissions from a blowdown. For pre-planned capital projects, Engineering would take direct responsibility for initiating project management and design. Specific tasks could include preparing a project scope and schedule, preparing welding procedures for installing stoppers, purging and calculating gas loss.

For emergency situations, Engineering staff would typically assist Operations staff to support the blowdown operation by completing engineering calculations (e.g. purging and gas loss calculations) and by preparing emergency procedures. Engineering

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<sup>7</sup> For detailed definitions and information about methodologies for protecting safety when conducting purging operations, see AGA Purging Manual, 4<sup>th</sup> Edition, AGA Publications Catalog No. XK1801, © American Gas Association 2018. Available at AGA's Publications Store: <https://www.aga.org/news/publications-store/>.

would also manage internal communication requirements. External communications would likely be coordinated through the Public Affairs department, as needed.

### **C. Gas Control**

Gas Control should be notified when a project involves a blowdown. For pre-planned O&M activities and capital activities, Engineering, coordinating with Gas Control, would take direct responsibility for supporting the scheduling and clearance of the project. In this context, “clearance” means giving Operations permission to work on a section of the pipeline. Specific tasks can include coordinating the blowdown with other company activities, using mainline or storage compressors or “district” regulators to lower pipeline pressure in order to reduce the volume of gas released, and diverting gas to another system. Communication requirements may include both internal company and external audiences (e.g. other gas pipeline companies).

For emergency situations, Gas Control would take direct responsibility for supporting clearance of the project. Specific tasks can include using mainline or storage compressors to lower pipeline pressure in order to reduce the volume of gas released. Gas Control will have responsibilities to communicate with internal company stakeholders, including calculated gas volumes.

### **D. Environment**

For pre-planned capital projects or pre-planned O&M activities, the Environmental Department (Environment) will take indirect responsibility – i.e. they will coordinate with and play a supportive role for the department that is taking the lead - for supporting the tracking of blowdown gas volumes. Specific tasks can include keeping records and advising Operations & Engineering regarding any regulatory constraints or considerations. Communication requirements include both internal company and external (air regulatory agencies).

For emergency situations, Environment will take indirect responsibility for supporting the tracking of blowdown gas volumes.

In the case of both pre-planned and emergency projects, the Environmental Department will be responsible for reporting any emissions that are required to be reported to a state agency or the U.S. EPA. For example, methane emissions from certain large blowdowns on natural gas transmission pipelines must be reported to EPA under the “Subpart W” Greenhouse Gas Reporting Rules for natural gas operations, known as “Subpart W.”<sup>8</sup> Personnel in the Environment department should consult with the company’s Office of General Counsel (i.e. Legal) regarding the applicability of state and federal regulatory requirements.

### **E. Gas Measurement**

For pre-planned capital projects and pre-planned O&M activities, the department in charge of gas measurement (Measurement) will take indirect responsibility for supporting the tracking of blowdown gas volumes. Specific tasks can include tracking gas blowdown volumes in the lost and unaccounted for gas calculations. The gas measurement department should communicate internally with company personnel who need this data for both capital projects and O&M activities. In the case of pre-planned capital projects, Measurement should also communicate with personnel charged with external environmental sustainability reporting.

For emergency situations, Measurement will take indirect responsibility for supporting the tracking of blowdown gas volumes. Specific tasks can include tracking gas blowdown volumes in the lost and unaccounted for gas calculations. Measurement’s communication requirements include internal company stakeholders only.

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<sup>8</sup> 40 C.F.R. Part 98, Subpart W.

## **F. Sustainability**

Many AGA member companies participate in voluntary programs that call for sustainability reporting that goes beyond regulatory requirements, including reporting methane emissions and emission reductions. These programs include U.S. EPA's voluntary Methane Challenge program, ONE Future, the EEI-AGA Environmental, Social, Governance (ESG) Sustainability Reporting Template, and the EEI-AGA Natural Gas Sustainability Initiative (NGSI). In some companies, this sustainability reporting function may be performed by the Environmental Department, and in others it may be performed by a separate sustainability group (Sustainability). Whoever performs this function will need to contact Gas Control and Operations to obtain data on methane emissions from blowdowns and data on emissions that were avoided or reduced by using methods such as those described in this white paper.

For both pre-planned capital projects and pre-planned O&M activities, Sustainability may take responsibility for supporting the tracking of blowdown gas volumes. Specific tasks can include capturing the blowdown volumes that are required for sustainability reports. Communication requirements may include both internal company and external audiences.

Similarly, for emergency situations, Sustainability will take indirect responsibility for supporting the tracking of blowdown gas volumes. Communication requirements include both internal company and external audiences.

## **G. Legal**

Project planners should consult with the company's legal department for legal advice as appropriate in accordance with company policy and guidance, for example where there are questions relating to regulatory requirements.

## **G. Public Affairs & Communications**

For pre-planned *capital projects*, a company's Operations Department would typically take the lead and the public affairs and communications department (Public Affairs) would take indirect responsibility for advising Operations and supporting the communication of the event to the public and local first responders, particularly if the project will be located near a developed area. Communication requirements include both internal company and external audiences (e.g., public, sheriff, fire department, news media and other entities, as needed).

For pre-planned *O&M activities*, Public Affairs will take indirect responsibility for supporting Operations in communicating the event to the public and local first responders. Communication requirements include both internal company and external audiences (public, sheriff, fire department and other entities).

For *emergency situations*, Operations would typically take the lead and Public Affairs would take indirect responsibility for supporting the communication of the event to the public and local first responders, coordinating as needed with Legal. Communication requirements include both internal company and external audiences (public, neighbors, sheriff, fire department, city hall and other entities).



## CHAPTER 2

### METHODS TO AVOID A BLOWDOWN

Sometimes, the best way to reduce blowdown emissions is to avoid having to blow down the pipe or ancillary equipment in the first place. This option may not be possible in many instances, but it is worth considering as a company develops and updates its operations procedures. There are several questions to ask: Is the work and blowdown necessary? Can the project be combined with other work to avoid multiple blowdowns? Is there another solution that will provide equally safe and reliable service? And if the work *is* necessary – e.g. adding a new service line, checking pipe integrity or making a repair – can one perform the work on a live pipeline that still contains natural gas under pressure – without blowing down and purging the line first? The following describes some techniques that may allow a company to answer yes to those questions.

**Hot Taps.** A Hot Tap can be used to add a new lateral or service line. This allows the operator to cut into a live line and establish a feed into the new line with minimal loss of gas. An advantage is that, generally, using a hot tap can help avoid interruptions of service.

**In Line Inspection Tool (ILI) Integrity Testing Alternative to Hydrotesting.** To avoid having to blowdown a line to hydrotest it, consider whether it would be feasible to make the line piggable so that an In Line Inspection (ILI) Tool (aka “smart pig”) could be used to inspect the line to determine its integrity. Evaluate first whether doing so would actually reduce emissions appreciably in a particular project. This may vary depending on the specific circumstances of your pipeline and the ILI tool used.

**Coordinate other projects that require blowdowns on the same system.** This method could reduce the number of blowdowns and, therefore, also reduce the volume of natural gas released. On the downside, it could result in delayed repairs. Thus, this option cannot be implemented for emergency events such as serious gas leaks.

**Stopper and Bypass Loops:** It may be possible to eliminate a blowdown and resulting emissions by installing two stoppers and a bypass loop. One advantage to this approach is that this method helps to provide continuous service to customers and adjacent pipelines during a repair project.

## CHAPTER 3

# METHODS FOR REDUCING EMISSIONS FROM A BLOWDOWN

### I. Introduction

This chapter identifies several major mitigation methods to eliminate or reduce blowdown emissions during natural gas pipeline capital projects and O&M activities -- Segment Isolation, Drawdown, Compression, Gas Flaring and/or Purging. Operators have historically used these methods to avoid or reduce odor complaints in urban areas when clearing lines of gas to ensure a safe working environment. These same methods are now being repurposed to take advantage of their environmental co-benefits. These methods, described in more depth in the following sections of this chapter, are frequently used in combination, and specific work plans are typically customized for each project.

It should be noted that we do not attempt to describe blowdown reduction technologies in granular detail for each potential application, as this would require discussing the specifications of specific product brands and models, which could raise issues under AGA's Antitrust Compliance Guidelines. Instead, this level of detail can be obtained directly from the vendors offering the competing products. Additional information, including contact information and website addresses, can be found in AGA's annual Buyers' Guide, available on AGA's website under Publications.<sup>9</sup>

Segment Isolation: The identification of an existing valve or valves that can be closed or locations where an isolation stopper fitting, or more than one such fitting, can be installed to isolate the shortest segment of pipe practical to complete the project.

Drawdown: The practice of reducing system pressure within the pipe segment to be blown down or diverting gas to other pipelines, mainly by using existing system configuration and compression, without compromise to the system. This is achieved by isolating the source of gas and (a) allowing the downstream load to draw down the pressure or (b) by

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<sup>9</sup> <http://naturalgasindustrybuyersguide.com/>

using an existing or temporary bypass to divert the gas to a distribution or transmission line that operates at a lower pressure than the line being emptied.

Temporary Mobile Compression: The use of temporary mobile compressors during a drawdown – or after a drawdown to remove most of the remaining gas – by boosting the pressure of the remaining gas in the line to be evacuated to a level above that of the neighboring (previously higher pressure) line, causing the gas to move into the neighboring line. It may also be possible for the remaining gas to be compressed and re-injected downstream of the valve or stopper back into the same line. A range of temporary mobile compressors are available to perform this function from relatively low to high pressure lines, up to a pressure differential above 2000 psi (a level not found in natural gas transmission systems but that would more typically be found in natural gas production operations). There are currently no commercial temporary compressors available for very low-pressure gas distribution mains; however, at least one utility company has developed its own prototype for use in very low-pressure mains. Note that while in theory it might be possible to create a vacuum to eliminate virtually all the gas in the line without emitting it to atmosphere, as a safety precaution, the current practice is to stop reducing pressure on the line when it reaches ambient/atmospheric pressure, or between 0.5 to 3 psi, using a pressure safety valve. The reason to avoid creating a vacuum in the line is that when valves are opened to purge the line with an inert gas, a vacuum could cause air to rush into the line, potentially creating an explosive environment. Another reason to avoid creating a vacuum is to avoid the risk of collapsing the line. Further research is required to determine whether a method could be developed to reduce pressure closer to a vacuum while eliminating these safety risks.

Gas Flaring: The use of a flare to combust natural gas in lieu of venting it to the atmosphere.

Purging: Removing gas or air from the pipeline, often with the use of an inert gas such as nitrogen. This chapter will discuss methods for reducing emissions during the purging process.

These and other best practices can be utilized to create a decision tree for individual natural gas systems that incorporate local infrastructure and operating procedures. The use of one, all, or a combination of these practices can, with appropriate weighing of potential risks and safeguards, create safe pathways to minimize or mitigate the need to vent gas to the atmosphere.

## **II. Segment isolation**

### **A. System configuration – Shortening the Pipe Segment to be Blown Down**

The overall configuration of a gas system can have a significant effect on the length of pipe that would need to be blown down or purged if a project requires the line to go out of service, thereby having a direct impact on the volume of emissions released. Several aspects of system configuration come into play, but some of the major factors that can have the most effect include valve locations, looping of the system, two-way feeds, and pipeline material described below.

**Valves:** Where a company has valves in its system, these valves can provide a quick and easy way to shut down and isolate sections of the system. Closing existing valves requires minimal time or equipment and can dramatically reduce the length of pipe needing to be taken out of service during a project – depending on where the valves are located. Many companies have recognized this value and have design standards calling for installing valves when installing or replacing mains. For example, this can be accomplished by installing valves at standard intervals on long single lays and by placing a valve junction where pipelines intersect. Although installing valves can add cost to the original investment, it is an option worth considering since it is a valuable tool both for reducing future blowdown emission volumes and for general operational flexibility.

**Squeezing-Off Plastic Pipe:** Pipeline material can also impact an operator's ability to take a smaller section of line out of service. If the pipeline is made of polyethylene (PE), then many operators will have the ability to squeeze-off the PE pipe, thereby cutting off

the flow of gas. It should be noted that squeezing off PE pipe can be limited by pipe diameter or other company specific factors. Companies may have specific guidelines setting a diameter limit for squeezing off PE pipe.

**Branch Connections - Alternatives to Squeezing-Off Plastic Pipe:** Several vendors offer a technology that is designed to allow an operator to make branch connections on PE pipe on a live line without squeezing-off the line and cutting out a section. This technology allows in-line, large diameter PE pipe branch connections without squeeze-offs or cut-outs. See Figure 2.

**Figure 2. Branch Connections.**



Photos of “Supraflow” Tee branch connections as used in the field, courtesy of David Payne, PLCS, LLC.

**Bagging Cast Iron or Steel Low Pressure Pipe:** As with larger diameter PE pipe, there are options when it comes to cast iron or steel pipe to shut down the flow of gas without expensive equipment and specialized training. If the system is low pressure, there is the potential to use bagging<sup>10</sup> as a means of stopping off the flow of gas. Where the pressure is five psig or less, an effective method of stopping gas flow is to insert a deflated bag that looks somewhat like a balloon into the live pipeline. The bag is then

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<sup>10</sup> See Sarco Stopper Ltd. video demonstration, publicly available online: [https://www.youtube.com/watch?v=F2nMrN\\_B03k](https://www.youtube.com/watch?v=F2nMrN_B03k).

inflated inside the pipe, which stops the flow of gas. Work proceeds with the blowdown of the shorter length of pipe and repair work on the depressurized section.

Otherwise, an operator could consider stopping off the gas flow in cast iron or steel pipe, as described below.

**Figure 3. Photos of Pipe Flow Stopping Bags.**



Clear pipe shown is for illustration only. Photos courtesy of PLCS, LLC.



Photo of bag tubes installed, bags positioned and inflated, courtesy of David Payne, PLCS, LLC.



Photo of bagging completed, leaving two plugs, courtesy of David Payne, PLCS, LLC.

## **Stopper Fittings**

Pipeline stopping equipment is a useful technology for reducing the amount of natural gas released to the atmosphere during maintenance projects. Pipeline stopping equipment can stop or redirect the flow of gas when a section of pipeline is taken out of service. Existing pipeline sectionalizing block valves may be spaced multiple miles between one another, requiring the operator to vent long lengths of pipe unless stoppers are added. The length of vented pipe -- and thus the volume of vented gas -- can be greatly reduced by using stopping equipment near maintenance projects. There are two major types of stopping equipment: (1) Weld-on fittings with stopping equipment, and (2) smart pigging plugs. Both types of equipment can be equipped with two seals in series to provide a redundant, double blocking barrier. Both pipeline isolation solutions are available from multiple vendors, along with the services to install and operate the equipment. One of the advantages of using stopper fittings and equipment is that it helps to provide continuous service to existing customers and downstream pipelines.

It should be noted that stoppers are often colloquially referred to in the industry as “Stopples,” regardless of the vendor. The term has become commoditized in much the same way as Kleenex® or Xerox®. However, since Stopple® is a trademark registered by T.D. Williamson, we use the term “stoppers” or stopping equipment here to refer to all pipeline stopping and isolation devices. To the authors’ knowledge, there are at least three other stopper vendors. For example, Mueller manufactures Mueller fittings, Stats Group manufactures stoppers called Tecno Plug®, BISEP® and Bi-STOP, and Dresser manufactures stoppers called “Black Hawk” stop fittings. There may be other stopper providers as well. Figure 4 illustrates examples.

**Methods for Installing Stoppers** - Stopper fittings can be welded, bolted, or heat-fused onto pipe, depending on the pipe material and utility practices. These fittings provide a means to tap and install a stopper to shut off the flow of gas. Weld-on fittings are permanently installed on the pipeline to be isolated by two encirclement welds and two longitudinal welds. After welding the fitting on the pipeline, the welds undergo non-



destructive testing by means of leak testing, dye penetrant, or magnetic particle testing to ensure weld integrity prior to proceeding with tapping the pipeline. After successful weld inspections, a gate valve is installed on the flange or threaded end of the fitting providing a controlled access point where tools can enter and exit the pipeline without pipeline contents being released. Once the gate valve is installed, a tapping machine with a shell cutter is installed on the other end of the gate valve. The gate valve is then opened, and the tapping machine proceeds to tap the pipeline. The fitting becomes a pressure-carrying appurtenance to the pipeline once tapped. Once the line is tapped, the tapping machine is extracted, the gate valve is closed, and the tapping machine is removed. The plugging equipment is then installed on the same gate valve and introduced into the gas stream to isolate the pipeline. Once the isolation operation is complete, the plugging equipment is extracted, and a completion plug is installed on top of the welded fitting to bring the pipeline back into service. Weld-on fittings have the advantage of creating bypasses to keep the pipeline in operation if the flow must be maintained. Smaller branch weld fittings and bagging equipment is also available to provide cost-effective stopping in lower pressure lines.

**Smart pigging stoppers** can be inserted and directed through an in-service pipeline towards the section to be brought out of service. Smart pigging stoppers are non-invasive and remote-controlled allowing pipeline operators to minimize excavations and pipeline modifications when isolating and maintaining sections of pipeline. There are failsafe mechanisms and integrity checks that are communicated back to the operator when the pipeline section is brought out of service to ensure a safe working environment is maintained. The pipeline can remain in service until the stopping action of the plug is required which helps minimize downtime. Smart pigging stoppers are available through multiple vendors. A limitation of pigging stoppers that operators should consider is that no bypass can be made if the pipeline is unidirectional and flow must be maintained. Generally, pigging stoppers can only be used if the operator's pipeline has a pig launcher and receiver already installed. However, temporary pig launchers are now available and may be an option.

**Figure 4. Stoppers – Examples of Weld-On Fittings.**



Stopper® illustration, for 2- 24-inch lines,  
Courtesy of T.D. Williamson.

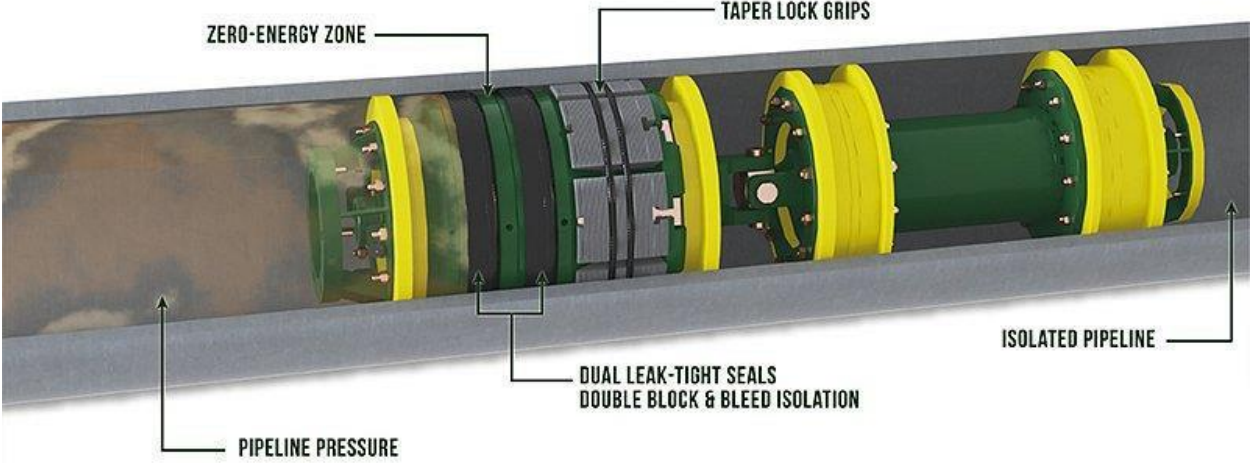


Stopper fitting and installation machinery,  
Courtesy of Xcel Energy.



“Bi-STOP” fitting for small bore pipe, courtesy of Stats Group.

Figure 4. Stoppers, continued.

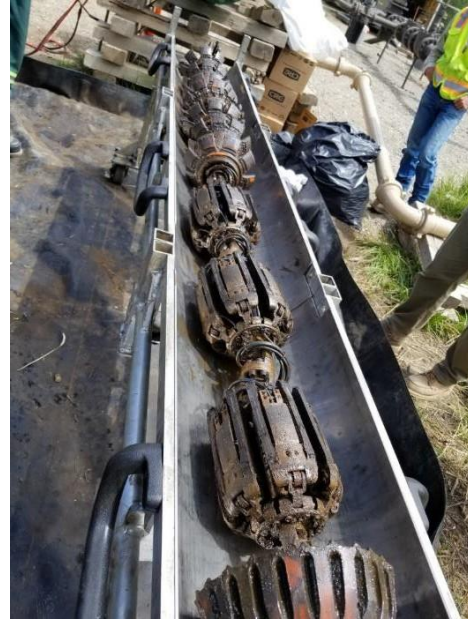


Techno-Plug® schematic, courtesy of Stats Group.

## Figure 5. Examples of Smart Pigs and Smart Pig Stopper.

See T.D. Williamson Video illustration showing insertion and removal of a smart pig stopper, publicly available online as of February 2020 at:

<https://www.youtube.com/watch?v=UMli5wluSu8>



ILI tools, courtesy of Xcel Energy.

**Decision Whether to Add Stoppers:** Each company must decide whether it would be preferable to use existing valving for a blowdown, or whether to add a stopper to shorten the distance of the overall pipeline being affected by the project. On the positive side, adding a stopper could both reduce emissions and reduce the number of customers impacted by a repair project. On the other hand, in some cases, time constraints, such as emergency repairs, may not allow for a stopper to be inserted. Capital costs for required stoppers and fittings could be high, and installation requires limitations on flow rates to ensure stopping equipment performs properly. Adding stoppers could also be labor intensive, since it requires specialized technicians and possibly additional excavations to install them. Moreover, while typically very little gas would be released during tapping and installation of a stopper, in some cases the

additional emissions from vehicles and equipment may limit the emissions reduction benefit of obtaining a shorter length for blowdown. To add a stopper, an excavation crew must be dispatched, drive to the target location, operate the excavation equipment to expose the pipe, install the appropriate fitting and the stopper equipment, and will of course reverse the process when the stopper is removed. Performing that excavation and stopper work burns fuel and causes emissions which should be considered when trying to minimize greenhouse gas emissions. Therefore, there will be certain pipe segments where reducing the length between existing valves by adding a stopper, though it would reduce blowdown emissions, could result in a net increase in greenhouse gas emissions measured as carbon dioxide equivalents (CO<sub>2</sub>e). This may be a factor to consider when evaluating a project.

## **B. Drawdowns**

### **1. Reduce pressure**

Before completing a blowdown procedure on natural gas lines, consideration should be given to determining if the pressure in the pipeline can be reduced, and if so, by how much and for what distance of the pipeline. In doing so, the amount of gas released to atmosphere can be minimized, which in turn, will result in minimizing the amount of methane emissions. This is a fundamental characteristic of gas under pressure -- the lower the pressure of the pipeline, the lower the amount of methane that will be contained in the pipeline.

**Downstream Compressors:** First, the pressure reduction can be achieved on a transmission line with existing compression by operating a downstream compressor after the upstream valve is closed to isolate the section. This method does not require any new capital equipment or labor cost and is usually a simple job with minimal man hours. There are incremental costs associated with operating inline compressors for fuel usage. However, the volume of fuel used is significantly less than the volume of gas that typically would have been released to the air.

**Re-Route the Gas to Another Line:** Second, pressure in a line can be reduced prior to blowdown by routing the gas to another nearby pipeline system with the same or lower operating pressure, if available. In some instances, pipeline operators may install a temporary pipe, which can later be taken out of service. This is a typical practice in station work.

**Downstream Customer Demand:** In yet another option, the pipeline operator can also close the upstream valve to isolate the section and then lower the pipeline pressure by allowing downstream customer demand to lower the pressure, while taking steps to safeguard safety and reliability. In populated areas, this can be done by using the demand load from large regulator stations which exist on the target pipeline segment. Alternatively, the natural gas company can discontinue feeding the source and allow the load on the pipeline to reduce the volume and pressure. However, this must be closely monitored to ensure that delivery pressures do not drop below service requirements, since most customers require a specified minimum supply pressure.

All three drawdown procedures require more advanced planning time than is needed to conduct a blowdown.

## **2. Divert gas**

If a lower pressure main is in the immediate area, consider diverting the gas into the lower pressure system rather than purging or flaring to atmosphere. In this instance, pipeline pressure can only be reduced to the pressure of the system into which you are transferring the gas. For example, if the pipeline to be blown down operates at 400 psig, and the lower pressure system operates at 200 psig, then blowdown emission could be reduced by up to 50 percent by completing the transfer of gas to the lower pressure line.

When diverting gas to lower pressure systems, it is important to consider how to connect systems if they have different Maximum Allowable Operating Pressures

(MAOPs). It may not be possible to simply connect the two systems with a pipe between the two of them. A portable regulator station or a throttled valve with gauging pressure may be required so as not to exceed MAOP. It is also important to note that equipment used (hoses etc...) are rated for the pressures they will see.

Diverting natural gas to a lower pressure system can be accomplished by two methods: (1) welded steel or fused PE pipe, and (2) flexible hose.

**Diverting Gas with Welded Pipe:** Diverting gas to a lower pressure system by welded steel or fused PE pipe will involve installing stopping or squeeze-off equipment, valves, stopper fittings and sections of steel or PE pipe. The pipe used to divert the gas to the lower pressure system will entail specific design and will be limited in diameter and pressure. Supporting the transfer piping must be included in the design in order to avoid stress on the pipeline and stress on the transfer piping itself.

**Diverting Gas with Flexible Hose:** Flexible hose can also be used to divert gas to a lower pressure system. Only hoses that are specified for natural gas applications should be used. Hydraulic oil hoses are not acceptable. Hose restraints must be installed to restrict movement in case of hose detachment. Diverting gas to a lower pressure system by flexible hose will involve the same materials required for welded pipe. These materials include installing stopping equipment, valves, and stopper fittings.

### **3. Temporary Compression – Maximizing Draw-Down and Diversion**

Another method of removing natural gas from a pipeline begins with drawing the pipeline's pressure down by re-routing the gas downstream of the valve or stopper or into neighboring pipelines and then isolating the sections to be worked on. However, not all the gas can be removed using this method. At some point the pressure of the line to be worked on will decrease to a level near the pressure of the receiving line. At this point gas no longer will move effectively into the neighboring line. Once that point is reached, there are three options to bring the pipeline to the gas-free conditions needed to ensure

a safe working environment: (1) vent the remaining gas to atmosphere, (2) flare the remaining gas – which reduces the GHG impact by converting methane into CO<sub>2</sub>, or (3) use temporary compression to divert most of the remaining natural gas into the receiving line and then vent or flare what little remains. For a sample “decision tree,” see Appendix A, Temporary Compression - Decision Flow Chart. Note that the chart evaluates the use of a temporary compressor combined with a vacuum pump, with controls as appropriate to prevent pulling a vacuum or negative external pressure in situations where that could raise safety or pipe integrity concerns.<sup>11</sup>

**Figure 6. Temporary Compressors.**

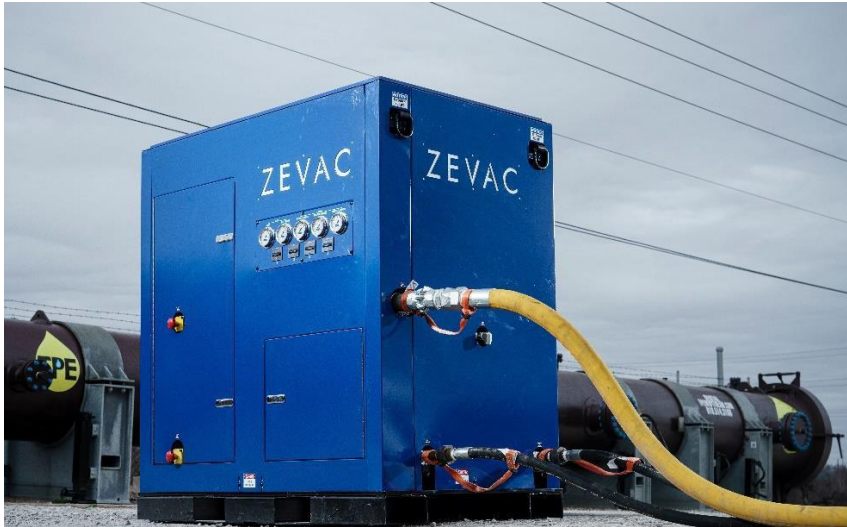


Photo of “Zero Emissions Vacuum and Compressor” ZEVAC® unit for high pressure projects, Courtesy of TPE Midstream.

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<sup>11</sup> In planning a project that will use a vacuum pump, it would be advisable to consult with your company’s Engineering department to avoid unintended consequences of pulling a vacuum, which could include collapsing pipe that is not designed to withstand external negative pressure, pulling grease out of valves, pulling air unexpectedly into the line through fittings, sucking valves into a stuck position, potentially pulling the wrong way on a pressure relief valve, or breaking regulators and other equipment with domes, diaphragms and pressure pilots. A method for reducing risk where these possibilities are a concern, is to deploy a “low pressure suction auto-shutoff” switch to prevent the vacuum pump from creating a vacuum.



**Figure 6. Temporary Compressors, continued.**



Temporary Draw Down Compressor for Medium Scale Projects, courtesy of Ryan N. Miller, Washington Gas.



Prototype Temporary Draw-Down Compressor for Small Scale Projects (Small Mains and Services), courtesy of Ryan N. Miller, Washington Gas.

Temporary compression can be used from the onset to evacuate gas from the line, or it can be used after a line has been partially drawn down. It can be useful to draw down first to create a lower pressure on the pipeline that is to receive the gas, which can help reduce demands on the transfer equipment and can help the evacuation proceed more quickly due to the pressure imbalance that is created.

To utilize temporary compression, the field crew will connect high pressure hoses to both the segment of the pipeline that is to be evacuated and a second line where the gas can be delivered. This may be a neighboring pipeline or the same line on the other side of an isolation valve. The compressor, which may be powered by natural gas or by a separate air compressor, then boosts the pressure of the gas in the line to be evacuated to a level above that of the neighboring line, causing the gas to move into the lower pressure line. The compressor then runs until the line being isolated reaches a pressure of about 45 psig on a transmission line and as little as 5-10 psig on distribution lines. At that point, the compressor will no longer operate efficiently, and the field crew will need to either vent or flare the remaining gas in the line, before purging removes the final residual amounts of gas.

Temporary compressors are available for rent from vendors who will provide support on set up, operation and tear down of the units, though some companies have chosen to buy units and manage their use with company employees. Mobile compressors can be mounted on a skid or truck and can be leased from compressor rental fleets, which may be costly. These compressors are typically powered by natural gas from the pipeline they are pumping down. Set up and removal of mobile compressors can be time-consuming. In addition, the time to compress and divert is often significantly longer than venting or flaring the same volume of gas.

Utilizing temporary compression offers a means of greatly reducing the gas volumes vented or flared to complete pipeline work.

### III. Flaring

Flaring natural gas is a process to combust natural gas in lieu of venting directly to the atmosphere. Flares can be either portable or fixed. While flaring activities require additional workspace to accommodate a portable flare unit and the appropriate flare radius, they also provide some valuable benefits, including a reduction in the carbon dioxide equivalent (CO<sub>2e</sub>) greenhouse gas emissions and a reduction in nuisance odor calls, as explained below.

**Figure 8. Blowdown Flare Illustrations.**



Flare operation, courtesy of Atmos Energy.



Blowdown Flares in operation, courtesy of Barry Smith, General Manager, Farr Front Chemical Services.

## Figure 8. Blowdown Flare Illustrations, cont.



Photos of Blowdown Trailer Flares, courtesy of Barry Smith, General Manager, Farr Front Chemical Services.

Notably, combusting methane will produce CO<sub>2</sub> and effectively reduces GHG emissions measured as carbon dioxide equivalents. Flaring equipment injects the right amount of oxygen to combust methane, resulting in emissions of carbon dioxide (CO<sub>2</sub>), other trace constituents and water. Since methane has a higher global warming potential (GWP) than CO<sub>2</sub>, flaring a blowdown event in lieu of directly emitting methane to the atmosphere would reduce a company's CO<sub>2</sub> equivalent emissions from vented gas.

Flaring methane may also reduce reporting obligations under the EPA GHG Reporting Rule for reporting "blowdown events" and related methane or CO<sub>2</sub> emissions from blowdowns of natural gas transmission pipelines. **To determine your company's regulatory reporting requirements, you should always consult with your company's legal counsel for legal advice based on your specific facts, such as the volume of emissions in relation to reporting thresholds, and applicable law.**<sup>12</sup>

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<sup>12</sup> Relevant federal GHG reporting rule provisions may include 40 C.F.R. Part 98, Subpart A §98.6 (definitions of "blowdown" and "blowdown vent stack emissions"); 40 C.F.R. Part 98, Subpart W

Other benefits of flaring include a reduction of odor, and as a direct result potentially fewer odor complaints, as natural gas containing mercaptan is combusted during flaring events. Additionally, flaring may result in less noise in comparison to a direct blowdown venting to the atmosphere. A variety of mobile flares are available for this purpose.

There are also some disadvantages to consider. The cost associated with acquiring flares and spending time to set up and remove the flares could be disadvantageous. However, costs and time could be reduced by using a drawdown operation in conjunction with a flare to minimize lost gas costs and flaring time. While flaring is not as loud as venting, it can still be noisy and may be associated with bright light if it is performed at night. This could raise community concerns about noise and light nuisances. One additional disadvantage of flaring is the potential of adverse community perception about the safety of flames. Public outreach and education may be helpful to explain the process and the precautions the company will take.<sup>13</sup>

Project planning should include an evaluation of potential risks and measures available to reduce the risks that otherwise may be posed by the high heat from a flare. Appropriate precautions should be taken to protect workers, the community and pipeline safety. For example, blowdown gas can be piped to a flare located some distance away from the pipeline or equipment to be blowdown. The flaring operation should have appropriate warning signs and a hazard work perimeter. The location of the project is important in this regard, and care should be taken to evaluate how to conduct a safe flaring operation, particularly near residential areas, forests, or areas with dry vegetation such as dry corn fields after harvest. It may be advisable in such situations to contact the fire department to stand-by.

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§98.233(m) (requiring reporting of CO<sub>2</sub> and CH<sub>4</sub> blowdown emissions from transmission pipeline blowdown vent stacks) and 40 C.F.R. Part 98, Subpart W §98.236(i)(3)(i)-(ii) (requiring reporting of “[a]nnual CH<sub>4</sub> emissions in metric tons CH<sub>4</sub> [and] Annual number of blowdown events.”

<sup>13</sup> Consider these issues in planning and consult with the company’s communications department. Flaring can result in complaints about bright lights at night, whereas blowdowns can result in noise and/or odor complaints. There are some measures that may be taken to mitigate light, such as placement of trucks or a screen to block light, and transparent communications can help reduce concerns.

With appropriate safeguards, flaring can be a useful tool to help reduce greenhouse gas emissions from blowing down a pipeline or compressor.

#### **IV. Reducing Emissions During Purging**

Purging is the act of completely removing gas or air from the pipeline, which is required before returning the pipeline to service or removing a pipeline from service. Either way, gas and/or air is released into the atmosphere for the purging to be successful.

One way this method can be more effective is with the use of inert gases. This is commonly described as a “slug.” A typical inert gas used in this process is Nitrogen. When performing a purge using a slug, the operator injects the inert gas into the pipeline followed up by either natural gas or air depending on which type of purge is being done. The slug helps prevent the mixing of gas and air during the purging process and allows for reduced purging times and an overall reduction of gas released to the atmosphere. The slug may also to sweep free liquids out of the pipeline being purged.

Continuous monitoring of the blow down stack during purging is another method to reduce emissions during purging activities. Continuous monitoring tools allow for a timely completion of a purging process, thus reducing the potential for unnecessary release of methane to the atmosphere.

A new method using vacuum extraction has recently been developed that may further minimize methane releases during the purging of pipelines into service. This new technical procedure, being evaluated by Gas Technology Institute (GTI), is designed to use vacuum extraction to eliminate trapped air in a new pipeline that is being brought into service, without purging the air and methane to atmosphere during pipeline commissioning. This is similar to the charge and recovery procedures used in the refrigeration industry to control the loss of refrigerant. In the process being evaluated by

GTI for use on pipe that is safely able to withstand the negative exterior pressure,<sup>14</sup> a vacuum pump is used to create a vacuum (negative pressure) in the new line segment. Once the pipeline has been drawn down to a vacuum, creating an airless pipeline, natural gas supply can then be introduced into the line. When the pressure between the supply pipe and the newly installed pipe is equalized, the new section of pipe is now charged with natural gas. This vacuum method is intended to reduce methane emissions to practically zero during the purging into service of a new gas pipeline, eliminating the need of using nitrogen as an inert gas. See Figure 9.

**Figure 9. Vacuum Pump Technology for Purging New Pipeline.**

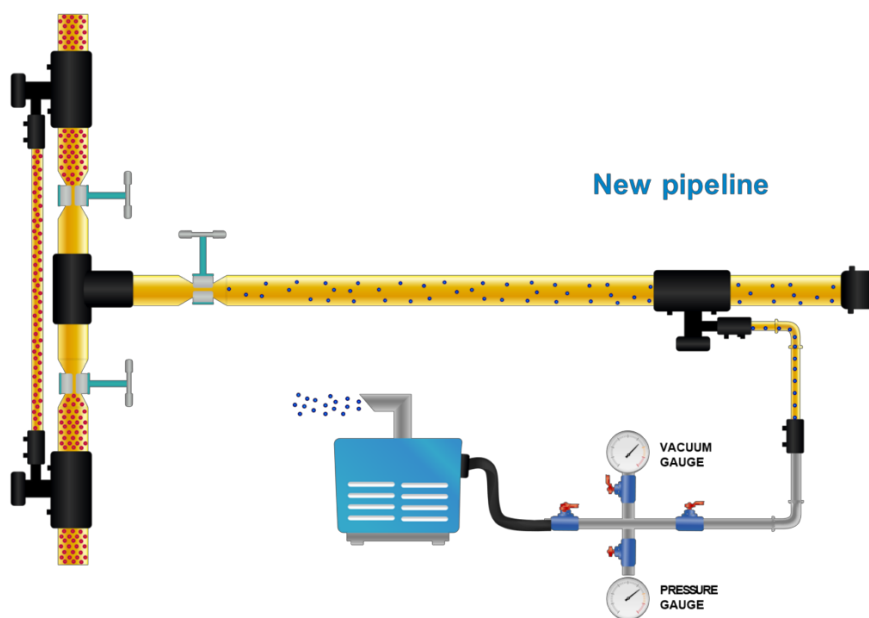


Diagram courtesy of Dennis Jarnecke, Gas Technology Institute.

The reader should note that while this white paper outlines techniques for reducing emissions from purging, it does not cover the many engineering tasks and safety controls involved in conducting a successful purging operation. As an example, for safety, it is important to avoid purging or blowing down a pipeline during electrical storms. For a comprehensive study of the theory and general procedures for safe and efficient purging

<sup>14</sup> Project planners should consult with their Engineering department when designing a project that will use a vacuum pump. See footnote 11, *supra*.

of natural gas systems in order to maintain a safe atmosphere inside and outside the system being purged, please refer to AGA's Purging Manual, 4<sup>th</sup> Edition, Sept. 2018.<sup>15</sup>

## **Other Emission Reduction Methods**

Other methods of eliminating or reducing blowdown emissions currently include the following.

**Squeeze-off Plastic distribution pipe until it is ready to be repaired.** This method is quick, easy and safe, but can be performed only once per location. This results in just a small amount of gas vented to atmosphere (downstream of squeeze point).

**Change Compressor Starter Method:** In operation of natural-gas driven engines at the compressor stations, which may be used to reduce pressure on a line prior to a blowdown, the starters can be changed from gas start to either instrument air or electric starter in order to eliminate emissions during start up. Check the manufacturer's specifications and recommendations for operation of the compressed air system and backup generators for any provisions relevant to starter operations.

**Portable Thermal Oxidation:** This method is similar to flaring, but it uses enclosed combustion, which may be preferable in some situations to avoid flaring in an open environment. Portable, trailer-mounted thermal oxidation units can be used to combust natural gas in an enclosed environment.<sup>16</sup>

**Combustion in Portable Heater (enclosed combustion):** This is another enclosed combustion method that can be used where a candle-stick style flare may raise aesthetic or other concerns, such as in urban areas. Portable convection heaters are commercially available

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<sup>15</sup> AGA Purging Manual, 4<sup>th</sup> Edition, AGA Publications n No. XK1801, © American Gas Association 2018. Available at AGA's Publications Store: <https://www.aga.org/news/publications-store/>.

<sup>16</sup> Information courtesy of GTI, Operations Technology Development (OTD).



and are commonly used to provide supplemental heat during winter months. While they do not have as large a capacity as an open flare, they are more discrete and draw less attention. These

units are usually designed for use with propane, but natural gas-fueled heaters are commercially available as well. A wide range of heaters are available that vary in size, cost, and capacity.

Multiple heaters can be used in parallel to combust a larger amount of gas and save time.<sup>17</sup>

### **Combustion in CNG Vehicles:**

For a utility with a fleet of natural gas vehicles, another method of enclosed gas combustion is to compress the natural gas and use the compressed natural gas (CNG) as fuel for a CNG vehicle.

This would require having an onsite compressor to compress the gas to a sufficiently high level.

Note that as the gas line loses pressure, more energy will be required to compress the gas into the vehicle's fuel reserve. Another issue with this method is the time that is required to fill the vehicle and combust the gas. Unless the utility has a fleet of many CNG vehicles to be filled, this method probably would not be a good option. A thermal oxidizer or portable heater may be a much more practical method of combustion.<sup>18</sup>

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<sup>17</sup> Id.

<sup>18</sup> Id.

## CHAPTER 4

# CONSTRAINTS ON BLOWDOWN EMISSION REDUCTIONS

### Introduction

The purpose of this chapter is to provide AGA companies with a general understanding of constraints that directly affect your ability to mitigate or eliminate emissions associated to pipeline blowdowns. There have been three major areas identified: Operational, Regulatory and Economic.

**Operational:** This area revolves around all the aspects of a company's operations including the assets, workforce, equipment, and overall culture.

**Regulatory:** Natural gas companies fall under review of several government entities that exert regulatory oversight at the federal, state and local level. Depending on the scope of their jurisdiction, each of these government entities and applicable regulations can affect what actions a natural gas distribution company or pipeline company can do when it comes to blowdowns.

**Economic:** When it comes down to the "How, What and When" decisions, almost all decisions relating to blowdowns will be subject to financial considerations. Understanding these considerations will help in making decisions on what options are available and feasible to mitigate or eliminate emissions, while being mindful of providing safe, reliable and affordable service to customers. Although not directly addressed in this chapter, the safety of your employees and the public will of course be a priority in planning and performing work to reduce or eliminate your emissions.

## **I. Operational Constraints**

### **A. Types of Systems**

The nation's natural gas system is made up of a vast network of interstate and intrastate transmission pipelines and local distribution pipeline systems with many operational characteristics. The ability to mitigate or eliminate emissions from a blowdown is heavily influenced by the type of system that is being blown down. The resources and processes used to mitigate or eliminate the emissions related to a blowdown on a larger transmission pipeline may not be suitable or practical for a small distribution pipeline, based on some or all the factors mentioned below. Compression may not be an option for distribution lines due to proximity to residential and / or business areas. Work area required to stage temporary compression equipment could be difficult to find in densely populated areas.

### **B. Pressure Levels**

The operating pressure of a pipeline or pipeline system is a critical factor when evaluating the ability to limit or eliminate emissions during a blowdown. This is primarily considered when selecting the appropriate mitigation option (e.g. flaring, cross-compression) and will impact equipment section. Cross compression requires an adjacent pipeline with an operating pressure compatible with the existing pressure conditions of the line to be vacated.

### **C. Location**

The nature of the site where the blowdown will occur is oftentimes one of the key constraints of mitigation or eliminating emissions. Some of the more common issues that are encountered at sites are size, grade, population density, proximity to roadways and critical facilities (e.g. hospitals, schools, etc.) and the existence of other pipelines or utilities in the area. If a project will occur in a residential area or heavily wooded areas, care should be taken when considering whether to use a flare to reduce emissions to avoid damaging homes or overhead electric lines or burning trees. All of these, and many others, are key considerations when choosing the appropriate mitigation option and the equipment that may be used.

#### **D. Pipe Material**

Modern pipelines are constructed of carbon steel and plastic pipe of many sizes ranging from less than 1-inch (e.g. a distribution service line) to upwards of 48-inches (e.g. interstate transmission pipelines). High and medium density polyethylene (PE) plastic pipe is typically only used in distribution pipe with diameters less than 8-inches (though some operators go up to 12-inches) while carbon steel is used across the entire spectrum of diameters. Some distribution systems also contain some cast iron pipe or earlier vintages of non-PE plastic pipe. The pipe material itself is typically not a constraint to emissions mitigation efforts; however, pipe material does impact the selection of other materials and equipment that would be used in reducing blowdown emissions.

#### **E. Change Management / Culture**

Another constraint on mitigating or eliminating emissions from blowdowns is change management. In some situations, venting natural gas to the atmosphere is the safest and most affordable solution to quickly reduce pressure in a pipeline. However, given increased focus on reducing methane emissions and the availability of several safe technologies that can be used to avoid the venting of large volumes of natural gas to the atmosphere, company personnel may be required to weigh the benefits and risks of several options to reduce pipeline pressure. Considerations include several variables such as safety and compliance first and foremost, cost, environmental impact, and available equipment. Without a company standard or decision tree to direct the method of blowdown in various operational situations, company personnel often default to historical practices and what is perceived as the safest method of blowdown. This can lead to the blowdown of natural gas to the atmosphere because “we’ve always done it this way and it was safe and successful.”

Implementation of change management is needed to mitigate emissions from blowdowns. Companies must first provide *awareness* of the benefits of reducing emissions from blowdowns. This can be achieved by developing effective and targeted communications

to share the business reasons (e.g. reducing environmental impact) for the change in practices and the risks of not changing. Second, companies can create the *desire* to change by assessing risks such as safety and designing tactics to address those risks and sponsor change at the appropriate level in the organization. Third, companies can develop the *knowledge* to change by providing effective training and coaching on several methods to reduce emissions from blowdowns. Fourth, the *ability* to reduce emissions can be fostered by providing a company standard or decision flow chart to guide the method of blowdown to select in various operational situations. Lastly, the change should be *reinforced* by celebrating successes and implementing recognition programs for emission reductions. Recognition can occur through the company, natural gas industry trade associations, non-governmental organizations (NGOs) such as environmental NGOs, and regulatory agencies. For example, the Methane Challenge Program is a voluntary program founded by the U.S. EPA in collaboration with oil and natural gas companies. The program recognizes companies that make specific and transparent commitment to reduce methane emissions, including commitments to reduce methane emissions from blowdowns.

## **F. Equipment**

As described in Chapter 3 (Methods for Reducing emissions From a Blowdown), mitigating or eliminating emissions from a blowdown can be accomplished by flaring, cross-compression, moving gas to lower pressure systems or reducing the size of the blowdown section to limit the amount of gas that is released to the atmosphere. In this chapter, we look at constraints on the use of these technologies.

The flaring option can reduce greenhouse gas (GHG) emissions significantly but can sometimes involve large equipment and requires the presence of an open flame. The use of an open flame can be a deterrent for some operators when the blowdown site is near homes, business or other critical facilities. Enclosed flares are available but can require more stringent operating requirements and are more costly.

Cross-compression pulls gas from one pipeline and directs it into a nearby pipeline. This can be performed using in-line compressors, if they are available, or portable compressors. Cross-compression is often a cost-effective method for eliminating emissions, but it is heavily contingent on equipment availability and having a qualified workforce.

Many systems have the flexibility of being able to move gas from a high-pressure to a low-pressure system. This allows the operator to draw the pipeline pressure down to much lower levels thus reducing the amount of gas that needs to be blown down. To eliminate emissions, or reduce them even further, the flaring or cross-compression option would also need to be used.

Another method of reducing emissions during a blowdown is to shrink the blow down section to the smallest length possible. The extent to which this can be accomplished is heavily influenced by the location of isolation valves or in-line stoppers as well as site-specific drivers such as roads, population density, and proximity to other pipelines or foreign utilities. This option would also still require flaring or cross compression to reduce or eliminate emissions.

#### **G. Qualified Workforce**

The availability of a qualified and well-trained workforce is a critical factor and can oftentimes be a constraint due to the growing levels of demand for these types of services and the specialized nature of the work. Workforce constraints can be exacerbated during emergency conditions, for example during recovery operations after a wildfire or major storm, and workforce constraints have been particularly tight due to the recent COVID-19 Pandemic. As different regions of the country emerge from the most severe constraints of the COVID-19 Pandemic, and as more operators begin to expand their emissions reduction and/or elimination requirements, the resource demand will grow and could put significant pressure on even normal, pre-Pandemic workforce levels. To overcome this, as COVID-19 Pandemic restrictions are eased, operators must ensure that the

appropriate employees are offered training in these areas, specifically on some of the more specialized equipment such as temporary compression and flaring.

## **II. Regulatory Constraints**

### **A. Regulations That Require Blowdowns**

There are prescriptive federal regulations that can require blowdowns. A prime example would be the Pipeline Safety Act of 2011. This regulation led to gas pipeline operators being required to verify testing records and to test any existing pipelines that did not have previous tests or records of the test. To comply with this rule, many miles of pipeline had to be taken out of service and evacuated of gas to perform the appropriate testing. Putting the safety of the public first should always be the top priority when it comes to operating a natural gas pipeline and with the timing and importance of this work, it was inevitable for gas to be released to the atmosphere as part of these new requirements.

### **B. Noise Restrictions**

When determining locations that pipelines can be taken down, whether it be a complete blowdown or by some other method to reduce or eliminate the blowdown, local noise ordinances must be considered for a given site. Depending on the site location, a variety of government agencies or other organizations may have mandates on limiting noise. These could include the city, county or state, and homeowner's associations. Most noise ordinances will impose restrictions on the decibel levels of noise and times at which they are permissible. This not only could affect the ability to blowdown a segment of pipeline at a specific site due to noise of the escaping gas, but noise restrictions would also affect the ability to use equipment such as a compressor or other means to reduce the rate of the gas escaping.

### **C. Property Owner Demands – Right of Way (ROW)**

Another potential constraint that must be considered when selecting the location for a blowdown is the list of demands made by the property owner. Pipeline is often installed across land owned by an entity other than the pipeline operator pursuant to an easement

contract with the property owner that grants a right-of-way (ROW) for the pipeline. Attempts to reduce the amount of pipe required to be blown down can be directly affected by the requirements or authorizations from the property owner. It is important to analyze the applicable easement or ROW agreement to determine how the agreement may restrict the options available for reducing blowdown emissions from the project. You should consult with your company's legal counsel and ROW department to evaluate the ROW agreement and what options may be available for your project. Depending on the ROW size, a temporary work site might be required that could be difficult or impossible to obtain if the property owner does not agree with the work being performed. When assessing the property and methods being used, the location of buildings and adjacent property owners should also be taken into consideration. Overall visibility and proximity of the site to the public can have a direct impact on the amount of complaints received.

#### **D. State Pipeline Safety & Utility Commission Requirements**

In addition to the prescriptive federal regulations previously discussed, many states have authority as a representative of PHMSA to implement federal pipeline safety regulations. States may also impose requirements that are more stringent than the federal requirements. The state agencies involved in pipeline safety regulation vary by state, sometimes including the state utility commission. In addition, state utility commissions regulate natural gas local distribution utilities to ensure safety, reliability and just and reasonable rates, and this authority affects funding and approval for a broad range of utility projects. California's actions following the 2010 natural gas rupture in San Bruno is a prime example of a state exercising its authority. The California Public Utility Commission ordered all four of the state's Transmission Operators to submit plans to bring their pipelines up to current testing standards. As in the case of the federal Pipeline Safety Act, this state order resulted in many pipeline blowdowns to allow the pipelines to be tested, and the timing acted as a constraint on implementing methods for reducing emissions from the blowdowns.



## **E. Other Regulatory Requirements**

Regulations can also establish prescriptive limits on how an operator must perform activities to meet the requirements of the regulation. This can limit the use of new, innovative equipment or procedures that may result in reduced gas released to the environment. An example of this would be in the area of leak detection where current regulations require the use of USEPA's Method 21. The Interstate Technology Regulatory Council (ITRC) has worked to advance the use of new technologies and techniques to be accepted as an equivalent method under applicable regulations. As technology continues to improve at accelerating rates, it is imperative that our processes and regulations adapt to take advantage of the efficiencies and cost savings in this ever-changing environment.

## **III. Economic Constraints**

### **A. Costs of Blowdown Emission Reduction Options**

As described in Chapter 3, there are several methods that may be considered by a pipeline operator to reduce or eliminate methane emissions when blowdown of a pipeline is required. In this chapter, we focus on the economic costs and constraints of different methods.

#### **1. Drawdown Cost Constraints**

An opportunity to reduce the volume of gas in a segment to be isolated is an effective means to reduce emissions regardless of the strategy chosen to evacuate the pipeline. Volume reduction is accomplished by operating valves and other equipment to suspend inlet feed to the pipeline while allowing system draw to continue. The subsequent "draw" on the line continues until the systems equalize to the pressure of the dependent system. As a result, the volume of gas under emission consideration is reduced due to the pressure reduction. In this scenario the project team could decide to emit the smaller volume of gas, achieving a reduction in the amount of methane released to the atmosphere and avoiding the additional costs associated with other reduction methods.

## **2. Stopping Cost Constraints**

The strategic placement of stopper fittings to reduce the length of pipe to be isolated is another option for reducing emissions. This can be done with or without the use of a bypass. If the stopper option is used without a bypass, then a decision must be made regarding the blowdown of the isolated segment. If the reduced methane level achieved by shortening the take down is acceptable then the project can proceed after the cuts are made and caps are installed on the active segments. There is additional material and labor cost associated with this option, particularly given that stopper fittings can be expensive. This will obviously increase project cost and must be considered when planning for the required capital and estimating the project's return on investment. These considerations may preclude deploying methods to reduce blowdown emissions unless the company's leadership has other priorities that take precedence, or the applicable economic regulator -- either a state utility commission or FERC -- makes such emission reductions a policy priority and approves regulatory mechanisms for cost recovery. Change management, discussed earlier in the chapter, may also be a factor in how costs and benefits are evaluated and prioritized.

## **3. Bypass Cost Constraints**

There are multiple options available for bypass, when required, depending on the project specifics. It is often possible to bypass a line by utilizing tees and valves that are part of the stopping equipment. The incremental cost of this option is related to the additional pipe needed for the bypass as well as the cost for the contractor to install and test. Typically, the crew must have the ability to complete the work the same day that the stopper fittings are operated. In order to utilize this method for longer replacement projects the new pipe should be installed parallel to the existing pipe while the existing remains active. The connections would then be made using offsets planned for one-day completion. This scenario would create the possibility of additional costs related to land rights if current rights do not allow for additional pipelines in the easement.

Additional fittings and labor are needed for projects that require bypass for a duration that is not conducive to utilizing the capabilities of the stopper equipment. This will likely include valves and other appurtenances that are permanently attached to the existing pipeline. Additional excavation will also be necessary to install the bypass pipe below ground. These factors result in additional cost to the project.

The costs associated with the stopper and bypass option increases significantly if this method is used when there are multiple segments along the same line to be replaced and the distance between them is large enough to necessitate a separate execution for each segment.

#### **4. Portable Compression Cost Constraints**

Portable compression is another option to consider for the reduction of methane emissions when isolating a pipe segment for replacement. These units draw suction on the isolated segment and discharge into an active adjacent pipeline. Several elements of this option can lead to additional costs.

Equipment availability is an issue that must be addressed. Companies that own a mobile compressor unit have greater schedule control, but significant capital investment is required to purchase the unit. Vendors that provide the service usually require customers to schedule well in advance. Stand-by charges from the compression vendor could result if the project is not ready when the vendor arrives.

The time required to move the gas is another factor that affects cost constraints. Long segments of large diameter lines can take several days to empty. The units are usually shut down at the end of each day and restarted the next morning. Pressure in the segment can rise overnight if closed valves do not achieve adequate shut off. Additional costs that could be incurred if compression time is excessive are related to labor and contractor stand-by cost.

In addition to the cost of the suction and discharge connections, the cost of labor related to operating and monitoring the unit must be considered.

## **B. Capital Allocation/ Return on Investment (ROI) (Carbon Credits)**

Implementing steps for the specific purpose of reducing or eliminating the emission of methane will likely increase the cost of the project. There are multiple cost impacts to consider.

Many operators plan capital budgets several years in advance. Implementing methane reduction policies will likely increase the capital required for each project and thus decrease the number of projects that can be performed each year if budget levels remain unchanged.

Projects driven by commercial agreements with a dependency on the projected return on investment can be negatively impacted by additional cost related to methane reduction. Operators will sometimes be forced to balance their commitment to reductions against the need for new revenue opportunities, especially when a project's rate of return is near the established threshold.

While not a new concept, carbon credit requirements have not been implemented in every state. The additional cost related to such requirements must be considered where applicable.

**C. Cost recovery – who pays?**

Most natural gas utility operators rely on recovery mechanisms approved by their respective regulators to generate financial return on capital investments. The incremental costs related to the management of methane emissions could be questioned by auditors and thus potentially jeopardize a company's ability to recoup the cost. It would be advisable to have a clear explanation of the benefits of the project and emission reductions available for auditors to review.

## **Chapter 5**

### **Regulations or Programs that Capture Blowdown Information**

#### **A. Regulatory Programs**

##### **1. Pipeline and Hazardous Materials Safety Administration**

The Pipeline and Hazardous Materials Safety Administration (PHMSA) is part of the U.S. Department of Transportation (DOT). PHMSA develops and enforces regulations for the safe, reliable, and environmentally sound operation of the U.S. pipeline transportation system and shipments of hazardous materials. PHMSA is comprised of two safety offices -- the Office of Pipeline Safety, and the Office of Hazardous Materials Safety. PHMSA regulations at 49 C.F.R. Part 191 contain reporting requirements for gas distribution, gas gathering, gas transmission, hazardous liquid/carbon dioxide, liquefied natural gas, and underground natural gas storage pipeline facilities. PHMSA incident reports include the estimated volume of gas release in an "incident" as defined in 49 C.F.R. Part 191.3.

##### **2. United States Environmental Protection Agency**

Owners or operators of facilities that contain natural gas systems and emit 25,000 metric tons or more of greenhouse gas (GHG) per year (expressed as carbon dioxide equivalents) report GHG data to the United States Environmental Protection Agency (USEPA). Owners or operators collect GHG data, calculate GHG emissions, and follow the specified procedures for quality assurance, missing data, recordkeeping, and reporting. 40 CFR Part 98 Subpart W consists of emission sources in ten segments of the petroleum and natural gas industry. Although not included in the original 2009 rule, a 2015 rule revision added calculation methods and reporting requirements for GHG emissions from blowdowns of natural gas transmission pipelines.

### **3. Energy Information Administration Form EIA-176**

The Energy Information Administration (EIA) is the independent statistical and analytical agency within the Department of Energy (DOE). The annual report, Form EIA-176, is a mandatory survey under 15 U.S.C. §772 for all companies that deliver natural gas to consumers or that transport natural gas across state lines. The Form is required from all identified interstate and intrastate natural gas pipeline companies, investor-owned and municipally-owned natural gas distributors, underground natural gas storage operators, synthetic natural gas plant operators, and field, well, or processing plant operators that deliver natural gas directly to consumers (including their own industrial facilities) and/or that transport gas to, across, or from a state border through field or gathering facilities. Respondents must file completed forms annually with EIA. Blowdown volume information is required as part of the form under the designation: *“Losses from leaks, damage, accidents, migration and/or blow down within the report state.”*

#### **B. Documentation**

Internal company documentation is important for capturing the data needed to report emissions from blowdowns and emissions avoided or reduced through the various methods discussed in this white paper, both for mandatory regulatory reporting and for voluntary initiative reporting. Parameters for documenting methane emitted or reduced from blowdowns may include, but are not limited to, pipe diameter, pipe length, pressure and temperature of the gas.

Note: Managing liquids that may result during a blowdown event and deodorizing natural gas during blowdowns are not discussed, as these topics are outside the scope of this emissions reduction white paper.

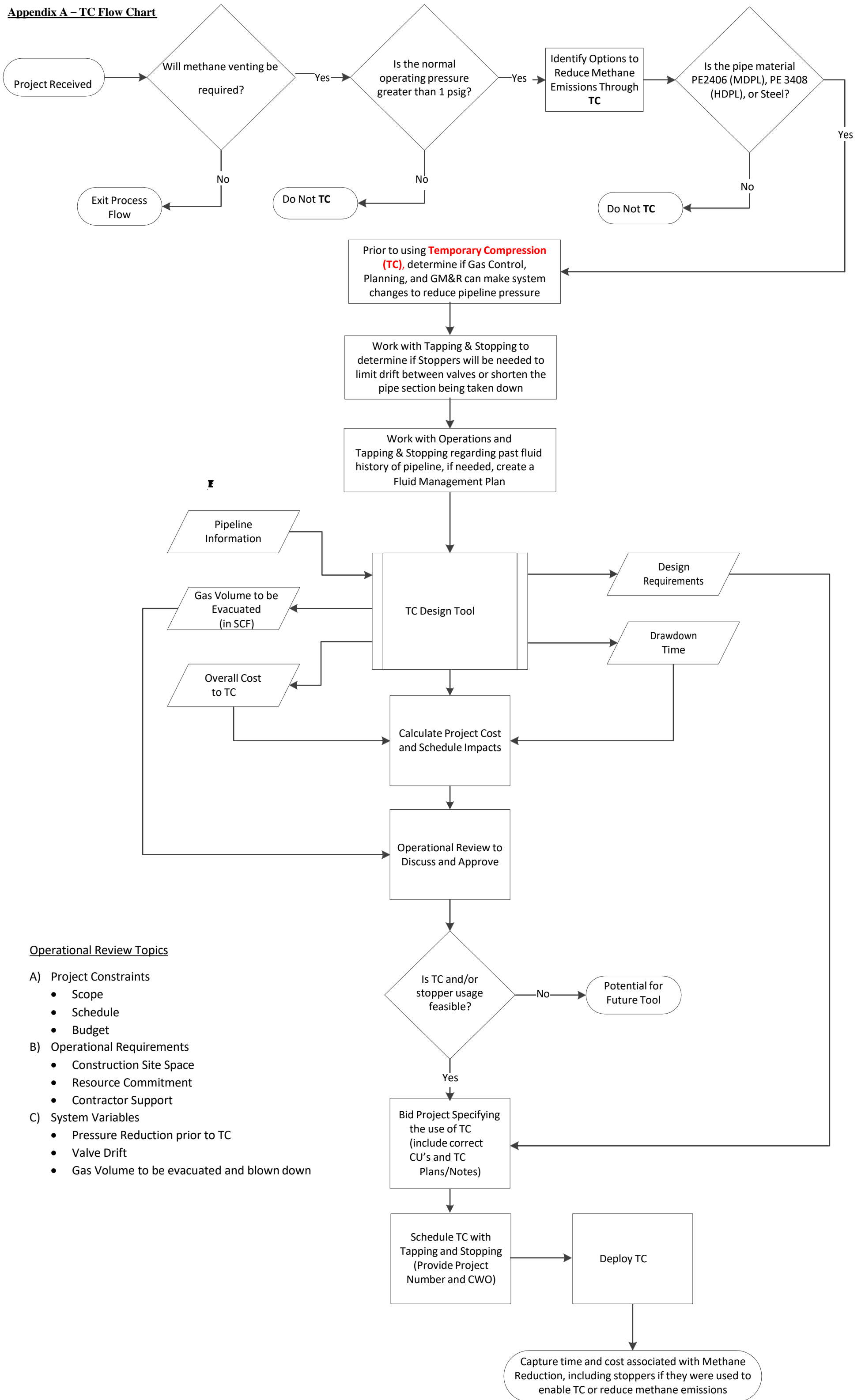
## **CONCLUSION**

Our industry is responding with ingenuity and creativity to address the challenge of reducing greenhouse gas emissions from blowdowns. Technologies and solutions are evolving rapidly as interest builds in reducing methane emissions. Accordingly, the authors anticipate that this white paper will be an evergreen document to be refreshed periodically as technologies evolve and improve.



**Appendix A**  
**Temporary Compression –**  
**Decision/Action Flow Chart**

**Appendix A – TC Flow Chart**



Operational Review Topics

- A) Project Constraints
  - Scope
  - Schedule
  - Budget
- B) Operational Requirements
  - Construction Site Space
  - Resource Commitment
  - Contractor Support
- C) System Variables
  - Pressure Reduction prior to TC
  - Valve Drift
  - Gas Volume to be evacuated and blown down