

-WHITEPAPER-

**Important Gas Hazard Safety
Information for those
In the Oil & Gas Exploration Industry**

Prepared by:

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Disclaimer: Everyone reading this document should also purchase from NFPA, www.nfpa.org, a copy of the NFPA 56 and read and discuss all parts of it thoroughly. This document and the comments provided are no substitute for a thorough understanding of the complete standard. This document does not consider many other issues, some technical, that will also impact your organization as this standard is applied.

Little Awareness of Safety Rules for Pipelines and Equipment Gas Purging

A number of well development and operational safety professionals were asked about their knowledge of safety guidelines related to the purging and cleaning of natural gas piping systems. The results were shocking. Very few had ever heard of NFPA 56, (standard for the prevention of fires and explosions during the cleaning and purging of flammable gas piping systems), a national safety standard that has been in place now nearly 3 years. This whitepaper summarizes the standard and how it applies to the gas development and operations industry.

The Marcellus and Utica shale plays have brought a lot of press lately regarding what regulations might apply to piping systems including gathering linesⁱ. The thousands of wells will be drilled and now in process will see hundreds of miles of gas pipelines put into service along with compressor stations and midstream processing plants. Much of the focus appears to be regarding long term integrity issues surrounding where lines pass through or are near population centers. This is obviously important and vital to safety for the masses. The information contained in this article focuses on a different aspect and that is the safety of those workers that are in and around the actual construction sites and are putting these piping systems into service for the first time or taking them out of service for maintenance. There have been a number of well site tragedies that have already occurredⁱⁱ. In these years when this development is starting to ramp up, now is the time to change the culture and take advantage of everything out there that can enhance safety in every way possible. The oil and gas industry has a chance to apply knowledge gained from terrible things that have happened in other industries without painfully relearning those same lessons.

After several tragic events in 2009 related to natural gas explosions the US Chemical Safety Board (www.csb.gov), asked several standards making organizations to engage volunteer experts to attempt to help. The National Fire Protection Association (www.NFPA.org), was one of these groups. The world changed on August 10, 2010 when a new standard, NFPA 56, (Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems) was officially adopted. I am proud to have been one of the people who got to work on this committee to formulate the standard.

Although this standard was originally developed around industrial sites and power plants, I am of the opinion that it applies to many well development piping processes and mid-stream processes. I am also of the opinion that although PHMSA, (Pipeline and Hazardous Materials Safety Administration, www.phmsa.dot.gov) regulations mention things like purging there is much more practical helpful information contained in NFPA 56 than in anything I could find in the PHMSA regulations or any of its referenced documents on this topicⁱⁱⁱ. This one reference in 49cfr192 had very little practical information as compared to what exists in NFPA 56.

§192.629 Purging of pipelines.

(a) When a pipeline is being purged of air by use of gas, the gas must be released into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

(b) When a pipeline is being purged of gas by use of air, the air must be released into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

Example issues not addressed*:

1. What is moderately rapid?
2. Where is the gas or air going at the other end? How does it get vented?
3. What kind of isolation is required to isolate the flow of gas in the area being worked on?
4. At what point has the air been removed adequately? How would one know?
5. Is this guidance meant for connecting equipment or for vessels within a processing plant?

*NOTE: All of these issues and more are addressed in NFPA 56

I have assembled comments below that in my opinion point to how and why NFPA 56 applies to the well development and gas processing industries. I have also then summarized some of the key points from the standard that I think those in this industry should understand. I would encourage those involved in the design, installation and or operation of well related gathering lines, compressor stations, and fracking and operations to get the standard and read it for themselves.

Does the standard apply to the oil & gas industry?

The following are excerpts from NFPA 56 and comments I have prepared regarding these sections.

1.1.1 Applicability. This standard shall apply to fire and explosion prevention during cleaning and purging activities for new and existing flammable gas piping found in electric generating plants and in industrial, institutional, and commercial applications.*

Comment: I consider the development of oil & gas wells to be an industrial application. The Webster's definition of industrial is consistent with this interpretation.

1.1.1.1 Coverage of piping systems shall extend from the point of delivery to the gas-consuming equipment isolation valve.*

Comment: I consider the point of delivery in this case to be a well head. I consider the gas-consuming equipment to be anything downstream of the wellhead.

1.1.2 Non-application of Standard. This standard shall not apply to the following items:

- (1)*Piping systems covered by NFPA 2*
- (2)*Piping systems covered by NFPA 54*
- (3)*Piping systems covered by NFPA 58*
- (4)*LP-Gas (including refrigerated storage) at utility gas plants (see NFPA 59)*
- (5)*LNG facilities covered by NFPA 59A*
- (6) LP-Gas used with oxygen for cutting, welding, or other hot work*
- (7)*Vehicle fuel dispensers*
- (8) Commissioning and maintenance of appliances or equipment*
- (9) Vent lines from pressure relief valves*
- (10) Systems regulated by U.S. Department of Transportation (DOT) 49 CFR 191 and 192**

Comment: It is my understanding that most all gathering lines are not in (DOT) 40 CFR 191 and 192 because they are not near population centers. Hence, this would mean that all of those piping systems **are not exempt** from NFPA 56.

What are some of the key things this standard contains related to the gas well development business?

Before discussing some of the key issues in NFPA 56 that relate to the oil & gas industry, it's important to discuss some concepts that you might not be familiar with.

Purging is to free a gas conduit of gas or air or a mixture of both^{iv}. This concept leads to purging things out of service and purging things into service. For example, purging something out of service would be taking something that was operating it, venting off the pressure and then removing the residual gas and replacing with an inert substance like nitrogen so that it can become safe to open up and work on without a flammability or explosion risk. Purging something into service would be taking something that had air and usually then moving the air out with nitrogen and then bringing in gas such that a flammable mixture is never present in the piping system or device. Again, this minimizes the flammability or explosion risk.

Cleaning piping systems in the oil and gas industry is usually done with pigging. NFPA 56 stresses closed pigging systems when gas is used to move pigs and never the use of free gas blows for cleaning.

The following are 8 key points that are included in NFPA 56 that one would have to consider along with some comments regarding each point.

1. Retroactivity

The standard clearly applies to sites and installations built before the standard was published.

1.3.1 Unless otherwise specified, the provisions of this standard shall apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard.

1.3.2 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction and only where it is clearly evident that a reasonable degree of safety is provided.

Comment: In my opinion the biggest impact of the retroactivity clause is related to operational issues regarding taking piping systems and pieces of equipment safely into and out of service. This would include maintenance operations where things have to be isolated and gas vented off, purging, and then re-introduction of gas to put the systems back into service.

2. New Construction and possible retrofit issues.

Most EPC (engineer, procure & construct) contractors anywhere would be following these codes anyway. However, there could be instances where the requirements for the documentation portions of these like pressure testing records, are not well conceived at this time.

4.1 Piping System Construction. Flammable gas piping systems shall be constructed in accordance with ASME B31.1, Power Piping; ASME B31.3, Process Piping; or NFPA 54, National Fuel Gas Code, as applicable.

Comment: Review all the requirements of these codes for new installations or major retrofits that are occurring and be sure that important commissioning related issues are being handled correctly and are well documented with regards to things like pressure testing of piping. It is also in this design phase that it is important to consider things like purge points where gas can be safely vented to relieve pressure and nitrogen introduced.

3. Extensive cleaning and purge procedures will be required.

Detailed procedures will need to be developed for handling cleaning and purging procedures for new and existing facilities. There is an extensive list of considerations and requirements for these procedures as is indicated below.

4.3 Cleaning and Purging Procedures. Written cleaning and purging procedures shall be developed and implemented by a competent person.*

4.3.1 The written procedure for each cleaning and purging activity shall address as a minimum the following items:*

(1) Scope of Work & Site Specific Purge Procedure Development

- a. Cleaning and Purging Method*
- b. Piping & Instrument Diagrams (PID's)*
- c. Chemical & Physical Properties of Flammable Gas, Purge Media & Discharge Gas*
- d. Determination of purge end-point introducing flammable gas, inert gas, or air*
- e. Assessment and Control of Purge Inlet & Discharge Locations*
- f. Temporary Piping System Design*
- g. Personal Protective Equipment (PPE)*
- h. Training & Qualifications*
- i. Management Review & Approval*
- j. Restoration of Service*
- k. Target Design, Launcher/Receiver Venting Review For Pigging Operations*
- l. Regulatory Permits*
- m. Evaluation of Engineering Controls To Limit Potential Unintended Ignition of Gases (controlled oxidation, "flaring")*
- n. Written stand-down instructions to stop activity in a controlled manner*
- o. Hazards*

(2) Environmental Conditions & Work Locations*

- a. Establish and Clearly Identify Exclusion Zones where flammable gas-air mixtures are likely to exist*
- b. Limit Access For Personnel Not Directly Involved With Purge Operations*
- c. Assessment of Potential For Gas Migration (Building Openings, Adjacent Structures)*
- d. Prohibition of Hot Work Within Exclusion Zones*
- e. Lock Out / Tag Out*
- f. Impact of Environmental Conditions (Wind Speed, Direction, Temperature, Barometric Pressure) on Purge Operations*
- g. Vehicular & Air Traffic if Applicable*
- h. Topography*
- i. Noise Control / Monitoring*

(3) Communication Plans

- a. Pre-Job Briefings*
- b. Work Permits*
- c. Roles & Responsibilities*
- d. Emergency Response Plan*
- e. Facility Alarm, Alert & Warning Systems*
- f. General Facility Notification Prior to Start of Purge Operations*
- g. General Facility Notification At The Conclusion of Purge Operations*
- h. Notification of Regulatory Authorities as Required (Local Emergency Responders, Utility Operators, Community Officials, Environmental Authorities etc.)*

(4) Control of Ignition Sources*

- a. Bonding & Grounding Considerations*
- b. No Smoking or Spark Producing Work Within Exclusion Zones*

- c. Elimination of Hot Work Within Exclusion Zone*
- d. Static Electricity Ignition Sources at Discharge Point*

(5) Pre-Purge Piping System Assessment

- a. Assessment of Piping System for Trapped Liquids, Pyrophoric Solids, and other Flammable / Combustible Deposits Within The Piping System*
- b. Ensure that the Piping System is Properly Isolated*
- c. Limiting site conditions that impact the safety of the activity*

(6)* Purge Monitoring and Instrumentation

- a. Ensuring that Monitoring Instruments are Appropriate for Gas Being Purged*
- b. Training*
- c. Calibration*
- d. Monitoring Frequency & Reporting*
- e. Appropriate selection of Sample Point(s)*
- f. General atmosphere checks in vicinity of purge gas release*

Comments: Consider developing a corporate-wide template approach for implementing a checklist type of system that can document and vet cleaning and purge jobs as they occur. It is recommended that you consider one form or process for non-routine events and another for routine events.

4. Development of detailed cleaning and purging procedures

Detailed plans and procedures for cleaning and purging will need to be written and well documented and made available on the jobsite and shall include names of the primary developer and team members.

4.6 Documentation.

4.6.1 *Cleaning and purging procedures shall be documented and available at the job site.*

Comments: This process will require a culture change in many organizations. The strong documentation makes for a meaningful chain of accountability.

5. Written safety validations of procedures

Written safety validations, of the plans referenced above, will be required for each time the plans are used. The safety validation review will also need to document the persons who created it.

4.6.2 *The safety validation documentation shall include the following:*

- (1) Names, company names and addresses of the primary developer and other principal team members responsible for the safety validation*
- (2) Name, company name and address of the principal operational personnel representing the plant owner or operator*
- (3) Date of preparation and any applicable modification dates*
- (4) The completed safety validation in accordance with section 4.4*
- (5) Any procedures related to the safety validation and any limiting conditions identified in the management of change assessment required in section 4.5*

Comment: This step provides others that may not be intimately associated with the specific task a chance to provide fresh input and to validate the thinking of the group that prepared the plans.

6. Record retention issues

Purging cleaning and safety validation plans must be kept for 2 years. Training documentation must be kept for 5 years.

Comment: Some organizations have developed on-line web based approaches for having documents stored on a central server so that they can be easily referenced and immediately available on a sustainable basis.

7. Management of change

Management of change issues need to be integrated into gas purging tasks and plans as indicated below.

***4.5* Management of Change.** Written procedures to manage change to process materials, technology, equipment, procedures, and facilities shall be established and implemented.*

***4.5.1** The management-of-change procedures shall ensure that the following issues are addressed prior to any change:*

- (1)The technical basis for the proposed change*
- (2)The safety and health implications*
- (3)Whether the change is permanent or temporary*
- (4)Modifications to cleaning and purging procedures*
- (5)Employee training requirements*
- (6)Authorization requirements for the proposed change*

Comment: Review existing management of change procedures for how adequately they address gas line cleaning and purging issues. This step causes you to be aware of subtle changes that can make a difference when it comes to safety.

8. Training

There are considerable training requirements for all staff. Sites should have a process for providing training and certification of competent persons related to this topic and for personnel who would be participating in purge operations.

***5.1 Training.** Persons whose duties fall within the scope of this standard shall be provided with training that is consistent with the scope of their job activities.*

***5.1.1** Such training shall include hazards of flammable gas, hazards of any compressed gas used for cleaning or purging, safe handling practices of flammable gas and compressed gas as applicable, emergency response procedures and equipment, and company policy.*

***5.1.2** Personnel training shall be conducted by a competent person knowledgeable in the subject matter and shall be documented.*

***5.1.3** Training records shall be maintained for a period not less than 5 years from the date of completion of the activity.*

Comment: Consider developing staff that are subject matter experts who can lead training processes along with a qualification program for all of those that participate in purges. Include elements of knowledge transfer validation and hands on skill transfer in all of training programs. Part of this

program should also include general awareness training for everyone on site including even contractors that might be doing unrelated work.

Where do I start?

Get the standard and have your team read it. Claiming ignorance of the standard will never be a defense if something happens. I believe that your acceptance of this standard can come in a planned fashion with all parts of the organization understanding how adoption impacts them or it can come after litigation when plaintiff's attorneys realize that this standard is out there and not being utilized. This will of course likely be at the end of a trail of human misery, suffering, and possibly after huge financial settlements and possibly the end of a well development program for that organization.

Adopting NFPA 56 into your drilling and operations programs will mean some culture changes and there will be a learning curve. However, many organizations have already adopted it and are living it daily. It can be done and at the end of this road will be enhanced safety and minimized risks for your organization.

References:

ⁱFact sheet, gathering pipelines, from PHMSA;
<http://primis.phmsa.dot.gov/comm/FactSheets/FSGatheringPipelines.htm>

ⁱⁱ 4 recent deaths in 2012/2013 related to gas piping and compressor maintenance incidents, (many others injured). This is only a very superficial examination of widely reported incidents in the last 14 months.

2012 On April 6, **2 gas company workers were mildly burned** when attempting to fix a leak on a 4-inch gas pipeline in DeSoto County, Tennessee. The pipeline exploded and burned during the repairs.

2012 On June 8, near Canadian, Texas, **a trackhoe operator suffered burns**, after a fire from leaking 4-inch gas-gathering pipeline that was undergoing maintenance. Fumes entered the engine of the trackhoe and ignited.

2012 **A contractor was killed and two others injured** after an explosion at a BP gas compressor station in Durango, Colorado on June 25. BP, Halliburton, and the other contractors were fined \$7,000 each for safety violations in that work.

2013 A flash fire at a pipeline gas compressor station broke out when natural gas liquids ignited in Tyler County, West Virginia on April 11, **seriously burning 3 workers, two of whom later died**. The workers were performing pipeline pigging operations.

2013 Reuters, West Virginia Fracking Explosion **Leaves 5 People Injured**, July 8, 2013

ⁱⁱⁱPHMSA 49cfr192

^{iv}Definition of purging from NFPA 56

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