Natural Gas Quality Management Manual

Prepared by

Transmission Measurement Committee

August 2013

AGA
American Gas Association

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FOREWORD

Pipeline natural gas is not just methane, but rather a complex mixture of hydrocarbon and inert gases, sulfur compounds, moisture, and other trace constituents and contaminants. These numerous constituents form the basis of physical and chemical relationships that further define natural gas as a product. To this end, it is important to understand what is implied by the word "quality." In the traditional sense, "quality" implies excellence or superiority. However, when speaking in the context of "natural gas quality," the word "quality" simply means any of the features that describe the chemical or physical characteristics of natural gas.

The subject of natural gas quality has received a great deal of attention by all industry sectors, from the wellhead to burner tip. Although many technical and policy references are available, examination of these resources revealed an information gap in the area of the practical gas system operating concerns and management planning. This manual is intended to bridge that gap. This single-source, easy-to-use reference tool provides an overview of the technical considerations for gas quality management planning. It combines concepts from several resources to help piece together the gas quality puzzle and enhances the understanding of the comprehensive set of dependent and independent variables that define the term "gas quality."

It is generally recognized that a "one-size-fits-all" solution to gas quality management and planning is impractical if we are to balance the concerns of maximizing supply while minimizing impacts on gas transportation and end use. This manual highlights the technical considerations to establish reasonable and practical gas quality management guidelines to ensure this balance is realized, while continuing the natural gas industry's rich history of providing a safe, reliable, environmentally responsible, and cost-effective product to our customers.

Much of the information contained in this manual is found in a variety of existing technical resources. A list of these resources, although not complete, is included in this document. This manual is a compilation of publicly available technical literature, Internet information, and opinions of researchers and other experts in the industry. The industry as a whole is still learning about gas quality and its effects on pipeline infrastructure and end use. It is in the industry's best interests to continue research and dissemination of available history and experience. Even though attempts were made to gather information from reliable sources and correctly interpret it, this information should be used only for educational purposes. More in-depth analysis may be required to address specific situations within your company.

ACKNOWLEDGEMENTS

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REQUEST FOR SUGGESTIONS

This document is the first attempt by AGA to develop a comprehensive reference manual on the properties of natural gas and the management of natural gas quality necessary for safe, reliable and efficient operation of pipeline infrastructure and utilization by the end-use customers. There could be errors, omissions and ambiguities. To help us improve this document, please send your suggestions, using the form at the end of the document, to:

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1 Overview

1.1 Introduction

The subject of natural gas quality resurfaced in the mid-2000s as an industry imperative due to an expected increase in imports of liquefied natural gas (LNG) and the associated immediate need to address pipeline tariff and Federal Energy Regulatory Commission (FERC) issues regarding interchangeability and hydrocarbon liquid dropout. However, the subject of gas quality goes beyond these two specific concerns. It also includes accurate energy measurement and addresses issues of impurities and contaminants, including trace higher hydrocarbon species, volatile metal compounds, moisture (water vapor) content, oxygen (O_2), inerts (e.g., carbon dioxide (CO_2) and nitrogen (N_2)), sulfur compounds, bacteria, and other particulate matter. Publicly-available data regarding the variability of gas supplies are limited and have typically focused on a particular end-use issue, such as natural gas vehicles. Other studies have examined, in a broad sense, the practical aspects of national specifications and recommended language to be incorporated into pipeline tariffs.

This document pulls together much of the currently available information and is intended as a "tool" for the gas operator, providing a collection of technical information necessary to assess, monitor, and manage aspects of gas quality that could impact pipeline operations and end-user applications.

An understanding of fundamental gas quality management parameters is necessary to manage changes in existing supplies and to ensure new supplies can be safely accepted and are interchangeable with historical supplies. This understanding includes knowledge of the following parameters and constituents:

- hydrocarbon gas composition constituents, at least through C_6, with a valid C_{6+} split assumption
- inerts concentrations, including nitrogen, carbon dioxide, noble gases
- total sulfur, mercaptans, and hydrogen sulfide content
- oxygen
- moisture (water vapor)
- flowing gas temperature
- heating value
- relative density, cricondentherm hydrocarbon dew point (CHDP) or hydrocarbon dew point (HDP) at operating pressure
- Methane Number (MN)
- Wobbe Number (WN) and/or other interchangeability parameters
- trace constituents and other contaminants

Much of this information is available or can be calculated from existing gas monitoring equipment installations (e.g., gas chromatographs). The challenge in managing gas quality involves defining these parameters and constituents for a range of acceptability, so that supply is maximized while problems within the gas transportation, delivery, and end-use sectors are minimized. In many cases, these parameters and constituents are established in tariffs and

monitored by pipelines and local distribution companies (LDCs). Suppliers inevitably need certainty to assess options to provide the most economical supply selections to customers. A gas quality management plan is a critical tool in facilitating development of supply options needed in the future.

The challenge in managing gas quality requires definition of criteria for a range of acceptability such that supply is maximized. In many cases, specifications for gas quality limits are established in tariffs.

1.2 Scope

The scope of this manual is to provide the reference information necessary for gas system operators to assess, monitor, and manage variables that define the gas quality management plan. This includes:

- understanding the fundamental constituents and properties of natural gas
- understanding the basis of historical pipeline receipt and market area delivery data
- understanding pipeline and delivery system design and market area end-use requirements, including specific limitations at potentially sensitive points within the pipeline system
- understanding the gas constituents of concern and resulting properties and parameters, potential effects on delivery and end use
- conducting the ongoing data collection and retention necessary to define gas quality for a system
- managing gas quality changes

The gas supply picture in the United States is evolving to meet projected current and long-term demand. As a result, stakeholders across the value chain must understand that gas compositions change as new supplies are introduced to the pipeline system. It is this change that drives the industry to understand and define the acceptable ranges of variability without compromising transportation and end-use reliability and safety. In summary, this manual provides the gas operator with a practical set of guidelines and information necessary for developing a gas quality management plan and recognizes that *what is in the pipe is as important as the pipe itself*.