Subject Matter Study Report

**Texans Can Be Exposed to the Dangers of**

**Hydrogen Sulfide in Eagle Ford Natural Gas Gathering Lines**

April 2018

(Revised April 2019)

By

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**Texans Can Be Exposed to the Dangers of**

**Hydrogen Sulfide in Eagle Ford Natural Gas Gathering Lines**

**Executive Summary**

Breathing a hydrogen sulfide concentration of 500 parts per million (ppm) or 0.05% in air can cause death in a short period of time. A concentration of 5% natural gas in air is required to ignite a natural gas leak or rupture. Therefore, hydrogen sulfide is at least 100 times more dangerous to life than natural gas by itself.

The Railroad Commission of Texas (RRC) website indicates there are over 12,000 oil wells and permits for oil wells in the Eagle Ford Shale Play. There are also about 6,000 gas wells and permits for additional wells in the Eagle Ford Shale Play. About 3,000 drilling permits per year are being issued for the Eagle Ford Shale Play during the past seven years.

At least 27 counties are affected by oil and gas operations in the Eagle Ford Shale area. These counties include Atascosa, Bastrop, Bexar, Brazos, Burleson, De Witt, Dimmit, Fayette, Frio, Gonzales, Grimes, Karnes, La Salle, Lavaca, Lee, Leon, Live Oak, Madison, Maverick, McMullen, Milam, Robertson, Walker, Washington, Webb, Wilson, and Zavala.

The areas of highest hydrogen sulfide in produced natural gas include Atascosa, Bee, Bexar, De Witt, Frio, Goliad, Guadalupe, Karnes, La Salle, Live Oak, Medina, and Mc Mullen counties. These counties are within the traditional production area called the Edwards.

The greatest threat to people in the Eagle Ford Shale production areas is from gas gathering pipelines that can be up to 24 inches in diameter or higher and operated up to 1,000 psig while transporting large amounts of natural gas containing hydrogen sulfide. Gas gathering lines are exempt from Federal and State safety regulation going back to the late 1960s when gathering lines were small diameter, low pressure, and short pipelines in rural areas. This is no longer the case, because of high production rates due to hydraulic fracturing or “fraking”.

Neither the RRC nor the Texas Council of Environmental Quality (TCEQ) actively oversee the safety of natural gas pipelines. In Texas, gas gathering pipelines are freely allowed to use the power of eminent domain to build and operate pipelines in any manner wherever they wish. However, neither Federal nor State law specifically grants gas gathering pipelines the power of eminent domain.

In Texas, there are about 200,000 miles of production and gathering pipelines that are not subject to safety regulation. Produced natural gas must be properly treated before delivery into a gathering pipeline. Gathering pipelines are not required to monitor hydrogen sulfide and control the quality of gas delivered into their gathering pipelines.

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**Texans Can Be Exposed to the Dangers of**

**Hydrogen Sulfide in Eagle Ford Natural Gas Gathering Pipelines**

Introduction

Breathing a hydrogen sulfide concentration of 500 parts per million (ppm) or 0.05% in air can cause death in a short period of time. A rupture of a gathering pipeline in the Eagle Ford area can create a concentration of 500 ppm or more for miles from the rupture site if the natural gas is not properly treated to remove hydrogen sulfide before delivery to a gathering pipeline. For example, a ruptured 10-inch gathering line transporting a natural gas stream containing 10% hydrogen sulfide and operated at 200 psi can create a lethal amount of hydrogen sulfide miles from a rupture using U.S. EPA atmospheric dispersion guidelines for risk management. Many gathering lines are larger and operate at even high pressures.

The Railroad Commission of Texas (RRC) website indicates there are 12,225 oil wells and permits for oil wells in the Eagle Ford Shale Play. There are also 5,877 gas wells and permits for gas wells in Eagle Ford. About 3,000 drilling permits per year have been issued for the Eagle Ford Shale during the past seven (7) years.

The Eagle Ford Shale extends from the border of Mexico into East Texas. The Eagle Ford Shale is about 50 miles wide and 400 miles long with an average thickness of about 250 feet. This shale is found at a depth of 4,000 to 12,000 feet. It runs through RRC Districts 1 through 6; however, most of the oil and gas operations are conducted in RRC Districts 1 through 4.

At least 27 counties are affected by oil and gas operations in the Eagle Ford Shale area. These counties include Atascosa, Bastrop, Bexar, Brazos, Burleson, De Witt, Dimmit, Fayette, Frio, Gonzales, Grimes, Karnes, La Salle, Lavaca, Lee, Leon, Live Oak, Madison, Maverick, McMullen, Milam, Robertson, Walker, Washington, Webb, Wilson, and Zavala.

Texas RRC Rule 36 requires producers to report oil and gas wells and fields with an average of 100 ppm or more of hydrogen sulfide in the natural gas to prepare a special report using RRC Form H-9 to the RRC including the amount of hydrogen sulfide in the natural gas. In RRC Districts 1 through 4, 355 oil and/or gas fields reported an average hydrogen sulfide content of 100 ppm or more. District 1 contained 154 fields with dangerous amounts of hydrogen sulfide. District 2 contained 58 fields, District 3 contained 42 fields, and District 4 contained 101 fields containing dangerous amounts of hydrogen sulfide.

Counties with 28% to 97% of hydrogen sulfide in the produced gas include RRC Districts 1 through 4 included Caldwell, Fort Bend, Guadalupe, La Salle, Madison, Maverick, Mc Mullen, and Webb. Many counties contained oil and/or gas fields containing at least 5% hydrogen sulfide in the natural gas stream. These are extremely dangerous levels of hydrogen sulfide.

The RRC Compliance Guide for Rule 36 indicates the areas of highest hydrogen sulfide in the produced natural gas include Atascosa, Bee, Bexar, De Witt, Frio, Goliad, Guadalupe, Karnes, La Salle, Live Oak, Medina, and Mc Mullen counties. These counties are within the traditional production area called the Edwards.

Dangers of Hydrogen Sulfide

Hydrogen sulfide is a colorless, highly flammable gas with a characteristic odor of rotten eggs. The effects of hydrogen exposure depends on the general and respiratory health of each person.

The World Health Organization in Document 53, “Hydrogen Sulfide: Human Health Aspects” contains the following exposure effects of hydrogen sulfide:

Short Term Harmful Effects of Hydrogen Sulfide Exposure

|  |  |
| --- | --- |
| Exposure Amount | Exposure Effects |
| Over 91 ppm\* | Loss of sense of smell |
| Over 365 ppm\* | Respiratory diseases |
| Over 456 ppm\* | Death |

 \* parts per million

The U.S. Environmental Protection Agency (EPA) sets a hydrogen sulfide limit of 30 ppm for determining worst case health conditions from accidental releases from various industrial facilities. The Occupational Safety and Health Administration (OSHA) sets a hydrogen sulfide limit of 10 ppm for 8 hours of exposure and a limit of 20 ppm for short term exposure.

Additional data from other sources on the effects of hydrogen sulfide exposure by humans include:

1. At 100 to 150 ppm, the olfactory nerve is paralyzed (sense of smell is lost) after a few breaths.
2. At 320 to 530 ppm, pulmonary edema occurs with the possibility of death.
3. At 530-1,000 ppm, breathing stops.
4. At 800 ppm for 5 minutes, 50% of humans die.
5. At 1,000 ppm and over, humans immediately collapse with loss of breathing, even after one breath of air with hydrogen sulfide.

The effects of hydrogen sulfide on each person depends on the age and health of each person. The effects of hydrogen sulfide are also dependent on the duration a person is exposed to hydrogen sulfide in the atmosphere. Children, elderly, and immobile persons have a higher risk of death due to hydrogen sulfide exposure.

According to the RRC compliance guide on Rule 36, the dangerous characteristics of hydrogen sulfide include:

1. Hydrogen sulfide is colorless at room temperature;
2. Hydrogen sulfide is soluble in liquid;
3. Hydrogen sulfide gas is heavier than air and may accumulate in low places;
4. When burning, the hydrogen sulfide flame is practically invisible;
5. One combustion by-product when burning or flaring is sulfur dioxide, which is more toxic than hydrogen sulfide;
6. Explosive limits of hydrogen sulfide in air are 4.3% to 46%.
7. A hydrogen sulfide concentration of 10 parts per million (ppm) in air is safe for up to 8 hours of exposure;
8. A hydrogen sulfide concentration of 500 ppm in air causes dizziness, breathing ceases in a few minutes if prompt respirator assistance is not provided; and
9. A hydrogen concentration of 1,000 ppm in air causes immediate unconsciousness and death within minutes.

Hydrogen sulfide can also cause cracking of steel in production equipment and pipelines leading to leaks and ruptures. Special requirements for steel are needed to minimize hydrogen sulfide effects.

Title 30, Chapter 112 of the Texas Administrative Code covers control of air pollution from hydrogen sulfide. The Texas Commission on Environmental Quality (TCEQ), not the Railroad Commission of Texas (RRC) is responsible for enforcing Rules 112.31, 112.32, and 112.33 on this subject.

TCEQ Rule 112.31 on allowable emissions affecting residential, businesses, or commercial property sets a hydrogen sulfide limit at ground level of 0.08 ppm averaged over a 30 minute period if the downward concentration of hydrogen sulfide affects a property used for residential, business, or commercial purposes. No person may cause, allow, or permit emissions of hydrogen sulfide from a source or sources operated on contiguous properties to residential, business, or commercial properties.

TCEQ Rule 112.32 sets a ground level concentration limit of 0.12 ppm averaged over a 30 minute period for other than residential, recreational, business, or commercial purposes, such as industrial property, vacant tracks, and range lands not normally operated by people.

The TCEQ has only 13 air monitors that measure hydrogen sulfide in the air of Texas near populated areas. However, there is no monitoring of hydrogen sulfide in rural areas where most of the oil and gas operations are conducted. The TCEQ needs to have numerous air monitors for hydrogen sulfide in areas with oil and gas operations subject to Rule 36. The TCEQ does an inadequate job of enforcing rules 112.31, 112.32, and 112.33. Air quality monitoring is not performed by the RRC.

The TCEQ hydrogen sulfide limits apply to health and safety due to long time exposures. The 100 ppm short term exposure limit of the RRC is 1,250 times greater than the long term exposure limit of 0.08 ppm for long time exposure where people live, work, and play. How do the RRC and TCEQ enforce these vastly different limits? The answer is the TCEQ has no jurisdiction over oil and gas operations; therefore, long term health effects of hydrogen sulfide are not actively addressed by the RRC or any other agency in Texas.

Dangers of Gathering Pipelines

Because the natural stream from oil and gas wells are not required to remove hydrogen sulfide before transportation from the oil and/or gas lease, the greatest threat to public safety involves gas gathering pipelines. They transport gas from numerous wells and are located in many public areas including near homes and businesses in rural areas. Gas gathering lines in Texas vary from 2 inches in diameter to 24 inches and larger. Some of these gathering pipelines operate at internal pressures up to 1,000 psi. The RRC allows production and gathering pipeline companies to decide whether to classify pipelines as gathering or transmission. Gathering lines in rural areas are not subject to Federal and State pipeline regulation under Title 49 CFR Part 192. Gathering lines in Texas are not regulated under the pipeline safety function of the RRC. Classifying a pipeline as transmission and being subject to safety regulations increases costs and reduces profits. The choice to classify as many pipelines as gathering to avoid regulatory oversight is obvious, but at the expense of public safety.

The RRC website indicates that Texas has the largest pipeline infrastructure in the nation, with more than 439,771 miles of pipelines. The largest category of pipelines are the 176,000 miles of intrastate oil and gas production and gathering lines. However, the RRC only knows of the existence of a pipeline if the pipeline operator submits a T-4 permit request. If a T-4 request is not submitted, the RRC has no means to know of the existence of a non-permitted pipeline. Non-permitted pipelines are not included in the mileage of pipelines in Texas known to the RRC.

At least 30 days prior to the commencement of construction of any pipeline totaling one mile or more, each pipeline operator is required to file a Form PS-48 with the RRC indicating the originating and ending points of the pipeline, counties to be traversed, size and type of pipe to be used, type of service, design pressure, and length of the pipeline. Each operator of a sour gas pipeline facility (contains hydrogen sulfide gas) is also required to file a Form PS-79 for a Sour Gas Pipeline Facility Construction Permit.

Unfortunately, many production and gathering pipeline operators do not submit T-4 permit requests and Forms PS-48 and PS-79 to avoid regulatory oversight. Therefore, the mileage of interstate production and gathering lines is greater than the 176,000 miles known to the RRC, and is likely over 200,000 miles.

The vast majority of times, the penalties for noncompliance, if caught, are far less than the cost of compliance. The RRC penalties for all pipelines since 2011 have averaged $178,000 per year. None were for gathering pipelines. Another serious enforcement problem in Texas is the 1,400 pipeline operators issued permits to operate in Texas. Over 4,500 permits have been issued to pipeline operators including many gathering pipeline operators. Many operators have multiple permits. How can the RRC keep up with so many permit issuances and regulatory compliance? There is no pipeline operator approval process.

Many of the safeguards needed to protect the general public are found in greater detail than Rule 36 in Title 49 CFR Part 192 and pipeline industry codes and standards. However, the RRC continues to exclude all oil and gas gathering lines from regulation. The Federal pipeline safety rules allow each State to adopt additional and more rigorous pipeline safety requirements, even for gathering lines. Why hasn’t this been done? This would involve the pipeline safety division into RRC Rule 36 compliance enforcement which is grossly needed.

RRC Rule of 36

In the mid-1970s, a hydrogen sulfide release from an oil drilling operation in Denver City, Texas killed 9 people. On January 1, 1976, the Texas Legislature adopted Rule 3.36 to protect the general public from the hazards of hydrogen sulfide in oil and gas operations. Rule 3.36 was amended in September 1976, September 1985, April 1995, and November 2004. Rule 3.36 was renamed Rule 36 by the RRC and applies to oil and gas operations where the gaseous phase of fluids contain 100 ppm or more of hydrogen sulfide.

Rule 36 requires the Railroad Commission of Texas to require each operator who conducts the following operations to comply with Rule 36 and file a certificate of compliance with Rule 36. These oil and gas operations include:

1. Oil and gas well drilling,
2. Oil and gas well work overs,
3. Gas and water reinjection,
4. Oil and gas processing,
5. Oil and gas gathering,
6. Oil and gas transporting, and
7. Oil and gas storage.

Requirements of operator subject to Rule 36 include:

1. Provide safeguards to protect the general public from the harmful effects of hydrogen sulfide.
2. Sample, measure, and report the hydrogen sulfide content in the gaseous phase of fluids they handle and transport.
3. Calculate the maximum radius of exposure to hydrogen sulfide in the gas due to an intentional and an accidental release from operations subject to Rule 36.
4. Radii of hydrogen sulfide exposure in miles must be determined for a hydrogen sulfide concentration of 100 ppm and 500 ppm.
5. For drilling a well in an area where insufficient data exists to calculate a radius of exposure, a 100 ppm radius of exposure of 3,000 feet must be assumed until sufficient data exists to make the calculations required by Rule 36.
6. The Rule 36 equations for calculating radii of exposure are simple and require a calculation of maximum rate of gas flow and fraction of hydrogen sulfide in the gas.
7. All operators subject to Rule 36 shall provide additional control and safety provisions if:
	1. The 100 ppm radius of exposure from the release exceeds 50 feet and includes any part of a “public area” including a dwelling, business, church, school, school bus stop, or similar area;
	2. The 500 ppm radius of exposure from the release includes any part of a public road; and
	3. In all other areas where the 100 ppm radius of exposure from the release exceed 3,000 feet.
8. All operators subject to Rule 36 must provide “briefing of the public within each zone of hydrogen sulfide exposure”.
9. A certificate of compliance shall be submitted to the RRC indicating compliance or noncompliance with Rule 36 using RRC Form H-9.
10. Oil and gas production operators are to submit a RRC Form H-9 for each new well having a hydrogen sulfide concentration equal to or greater than 100 ppm in the wellhead gas.

Since the mid-1970s, the dangers of hydrogen sulfide have increased dramatically because of hydraulic fracturing or “fracking”. The flow rates of oil and gas production have increased dramatically due to fracking resulting in larger equipment and higher pressures. The potential release rates and impact radii are much greater today than in the 1970s. However, Rule 36 requirements and enforcement have not kept up with this increased threat to worker and public safety.

Problems with Enforcement of Rule 36

There are about 187,000 leases for oil and gas in Texas. There are over 180,000 oil wells and over 89,000 gas wells in Texas. Annual oil production in Texas is over 1 billion barrels or over 2.2 million barrels per day or about 50 billion U.S. dollars per year. Texas natural gas production is about 20 billion standard cubic feet a day or about 20 billion U.S. dollars per year.

The Mission Statement of the Texas RRC is to serve Texas by our steward of natural resources and the environment, our concern for personal and community safety, and our support of enhanced development and economic vitality for the benefit of Texas.

“Enhanced development and economic vitality” are primarily related to the wealth of companies inside and outside of Texas and the government of Texas and appear to be the primary focus of the Texas RRC. At over $70 billion U.S. Dollars per year, the choice of wealth over public safety is obvious. There are also benefits from jobs and royalty payments to land owners. However, these benefits are for a small minority of the State, not the majority that benefit from personal and community safety.

“Our concern for personal and community safety” is a weak statement of priority. Safety benefits all that live, work, and play near oil and gas operations and the pipelines they serve. In all decisions, the cost of safety improvements are usually weighed against the value of safety enhancements. Determining the cost of safety improvement are somewhat straight forward, but the value of safety enhancements is subject to extreme variability and are usually stated on the low side. Determination of the value of safety enhancements has always been a low priority for regulatory agencies. Catastrophic events are seldom considered. Therefore, safety has been and will continue to be a low priority of the RRC until a catastrophic event focuses on the inadequacies of safety requirements. The dangers of hydrogen sulfide provide the potential for such a catastrophic event.

All regulations of the State and the Federal government are stated in general, performance based language. The regulations generally state some of the activities to be performed by a regulated entity, but seldom how to comply with a regulation. This lack of detail or specification creates enforcement problems for every agency. In general, Regulations are stated as minimum requirements perceived by the Legislature and regulatory agency to be necessary for compliance with the law. Most regulatory agencies depend somewhat on the entity being regulated to determine how to comply with minimum regulatory requirements.

Rule 36 fails to specify the criteria for calculating a maximum rate of gas flow and fraction of hydrogen sulfide in the gas during an accidental release. Other regulations dealing with unintentional releases require a worse case rate of flow be used for such an analysis. For pipelines the worst case release flow rate involves a rupture of the pipeline that severs the pipeline in half.

Rule 36 is primarily based on technology and the degree of knowledge available in the 1970s. Rule 36 needs to be updated to today’s level of knowledge in a specification format that includes details for compliance such as EPA 40 CFR Part 68 on risk management programs for hazardous materials.

Rule 36 does not require the submission and approval of written plans, processes, and procedures to comply with Rule 36. There are thousands of operators that would be required to review for approval such written compliance programs.

For 2013 through 2015, there was an average of over 19,000 drilling permits issued per year. For 2013 through 2015, there was an average of about 20,000 new oil well completions in Texas. For 2013 through 2015, there was an average of about 3,700 new gas wells completed in Texas. The vast majority of oil wells also produce natural gas in the crude oil streams. For 2013 through 2015, there was an average of about 25,500 holes drilled in Texas. The scope of oil and gas production activities are vast and impossible to comprehensively police for compliance purposes.

Many operating companies have incorporated multiple affiliated companies to reduce the risk to the main company due a major oil or gas facility failure resulting in millions of dollars in fines and lawsuits due to deaths, injuries, property damage, and environmental damages. If one of the affiliates experiences a catastrophic event, the primary company declares bankruptcy of the small affiliate and walks away for accountability for their negligence. This practice is allowed in the State of Texas without limits. Greater accountability is needed, because the negligent practices of the smaller companies that experience a catastrophic event are usually caused by the policies, practices, and negligence of the main company.

The RRC Oil and Gas Division conducts about 116,000 to 134,000 inspections per year of oil and gas production operators. About 42,000 to 62,000 violations are observed during these inspections. Only two (2) to 37 violations of Rule 36 are reported each year, indicating Rule 36 is a very low priority. However, only 1,208 to 2,178 (about 1.3%) of these violations are addressed in oil and gas enforcement dockets. The number of Rule 36 violations reaching the enforcement dockets is not reported. The total amount of fines assessed for oil and gas operations in the State of Texas in the past six years have varied between $1,178,631 in 2013 to $5,048,940 for about 11 months in 2017. The violation prosecution activities are grossly inadequate to influence compliance activities of the huge number of oil and gas operators in Texas. Significantly higher penalties need to be assessed for violations to ensure compliance is significantly improved.

If 42,000 to 62,000 violations per year were noted, there were probably another 100,000 or more violations occurring that are not discovered. However, the limited inspection resources of the RRC cannot identify all the violations. The fines for noncompliance are not great enough to ensure compliance.

There are numerous states that contain oil and gas resources. There are numerous reasons why the oil and gas industry chooses to develop specific resources in a specific state. One such reason is a passive regulatory environment that favors the oil and gas industry. If a state becomes aggressive in the areas of safety and environmental protection, there is unlikely to be interest in spending money to develop oil and gas resources in that state. Therefore, state regulatory agencies know there are business and economic incentives for a state to have limited regulations and passive enforcement of safety and environmental protection regulations.

Another compliance problem with all oil and gas related regulations is a failure to require operators meet minimum technical capability and expertise needed to protect safety of the public in the State of Texas. Since the RRC regulations are based on generally stated, performance requirements, each operator must have considerable expertise to know how to comply. Many producers and gathering pipeline operators do not have this expertise and use little technology to address public safety.

Administration of Rule 36 is through the RRC oil and gas division and not the RRC’s pipeline safety divisions. There needs to be a coordinated extensive effort between the two RRC functions to protect the general public. The TCEQ should also be included in compliance activities. However, this joint cooperation does not exist. The public safety issues with hydrogen sulfide will never be solved unless a rule is passed that hydrogen sulfide is required to be treated at the lease site to reduce the hazards to a minimal level for public safety.

The failure of any regulatory agency to actively and aggressively enforce regulations encourages “regulatory cheaters”. In a passive compliance environment, a company has to cut corners on compliance activities to maximize profits and remain competitive with other “regulatory cheaters”. In such a regulatory environment, the regulatory agency does not contribute to the purpose in which the regulations were established. Why have a regulatory agency if they are passive and their contributions to the greater good are less than their cost to regulate?

What Action Can a Person Take to Assure Safety?

Unfortunately, contacting the RRC or TCEQ to take action on oil and gas production and on gathering pipeline safety issues is unlikely to result in any significant action. Because the existing laws and regulations are so vague, regulatory agencies do not normally take action until after an incident involving significant property damage, personal injury, or death occurs. There is little or no proactive action taken to protect the public and the environment by regulatory agencies.

The only action that has any chance of success is to hire an attorney and experienced licensed professional engineer to study the hazards and identify actions through the Texas courts needed to protect themselves, family, and friends.

Each person living near oil and gas wells and gathering pipelines in the Eagle Ford area should initiate action on their own if they want to ensure it is safe to live, work, and play in areas of oil and gas production in the Eagle Ford area.

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