Bakken-Evolving H_2S Issues, Challenges and Solutions

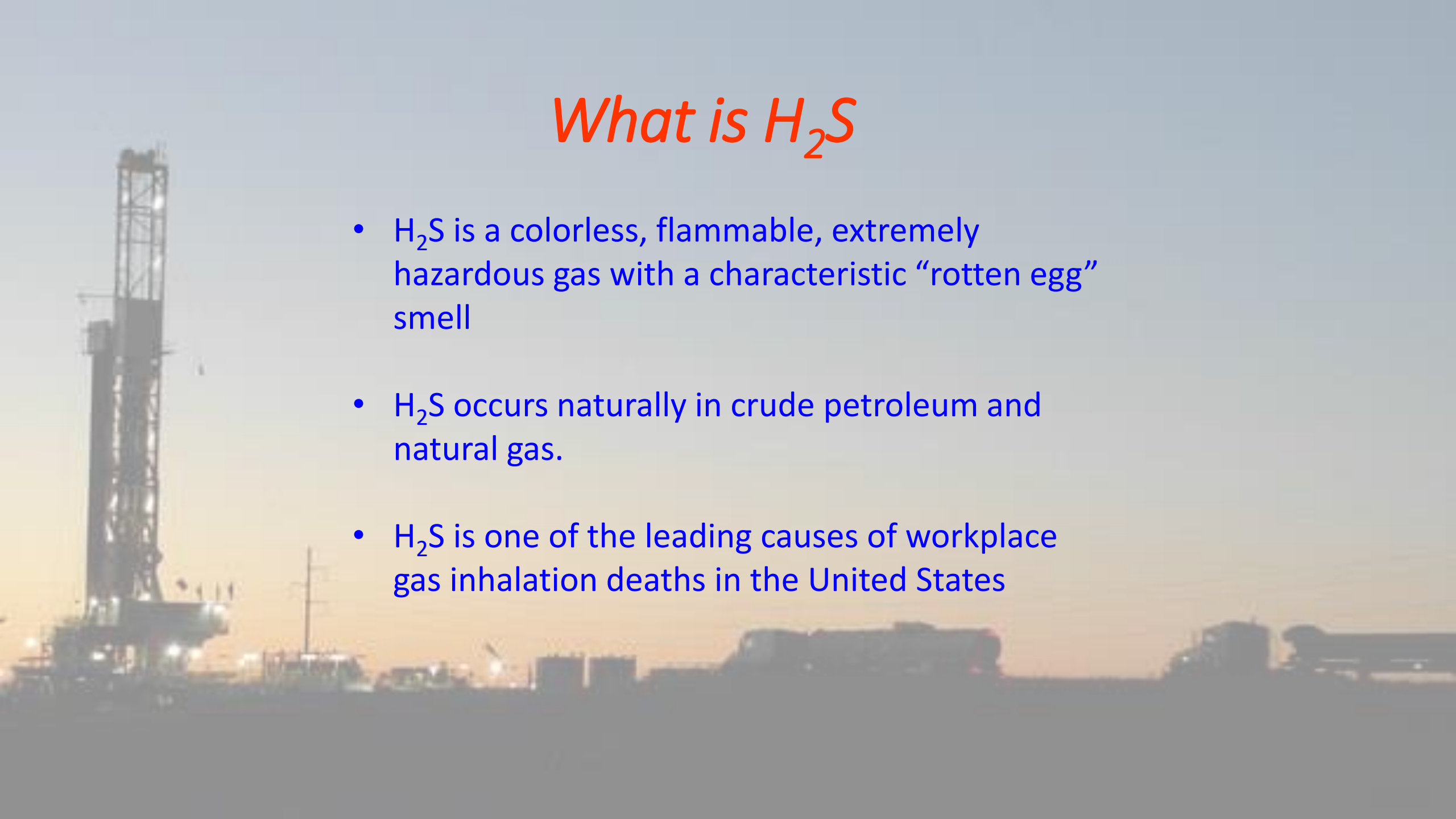
Jim Hughs

Bryan Weaver

ConocoPhillips, Facility Engineering

Overview

- What is Hydrogen Sulfide-H_2S
- History and Challenges of H_2S in the Bakken
- Health Effects of H_2S
- Technical Solutions
- Future Study



What is H_2S

- H_2S is a colorless, flammable, extremely hazardous gas with a characteristic “rotten egg” smell
- H_2S occurs naturally in crude petroleum and natural gas.
- H_2S is one of the leading causes of workplace gas inhalation deaths in the United States

History and Challenges of H_2S in Bakken Crude

- Bakken crude oil can contain potentially lethal concentrations of H_2S
- H_2S can pose safety, production, transportation and product quality issues
- H_2S Challenges/Concerns appear to be increasing throughout the Bakken
- H_2S Concentrations tend to differ between geographical locations and formation
  - Causal Factors are not completely understood
    - Increased/Larger Fracs??
    - Reservoir Gas Depletion??
  - NDPC-Technical Solutions Group is Proposing Further Study

Health Effects of H_2S

Low concentrations <100 ppm** – irritation of eyes, nose, throat, or respiratory system; effects can be delayed.

Moderate concentrations 100-500 ppm – more severe eye and respiratory effects, headache, dizziness, nausea, coughing, vomiting and difficulty breathing.

High concentrations >500 ppm Death may occur in seconds – shock, convulsions, unable to breathe, coma, death; effects can be extremely rapid (within one breath).

**OSHA IDLH 100 ppm

Why treat H2S?

Metallurgical Concerns

- Sulfide Stress Cracking (SSC)- NACE (National Association of Corrosion Engineers) MR0175 ISO15156 SSC
- Hydrogen Blistering

Health and Safety Concerns

- Acute and Chronic Health Concerns
- Flammability/Explosivity
- Scale Pyrophoric Properties

Product Quality and Regulatory Compliance

- Gas collection for sales generally has a limit of <4 ppm with 0 ppm sometimes written into contracts
- SO_X emissions can become an issues when H2S is combusted in flare system
- Oil offtake can also be rejected at 100ppm H2S.

Treatment Methodology

- ***Three methods that can cover the majority of H2S treatments***

  - **Chemical Solvents**
    - **React with the acid gas in the natural gas stream and reaction products are absorbed into the liquid phase.**
    - **Can be used in direct injection and as well as bubble tower applications**
      - **Example: Chemical scavengers (MEA Triazene, MMA Triazene, Zinc Oxide, and More)**

  - **Physical Solvents**
    - **Stripping process more geared toward plant facilities. Counter current tower flow of H2S and lean solvent that has high affinity for H2S.**

  - **Direct Conversions**
    - **Essentially are catalytic converters to oxidize H2S to produce elemental Sulfur and water (or other bi-products) .**
      - **Example: Iron Sponge is the most common H2S direct conversion unit for gas streams containing small amounts of H2S**

Treatment Methodology- cont.

- ***Treatment issues to consider***
  - **H2S concentration and post treatment target**
  - **Which process stream is to be treated and WHY?**
  - **Phase to be treated**
  - **Chemical Selectivity**
    - **Water vs Hydrocarbon**
  - **Downstream Concerns**
    - **Transporters including trucking, terminal, pipeline and rail**
  - **Alternative solutions**
    - **Signage, PPE, 4gas monitors, building enclosure monitors, etc…..**
  - **Cost and risk based analysis**

NDPC-Technical Solutions Group
Proposed H_2S Study

- **NDPC-TSG and North Dakota Oil and Gas Research Commission joint effort**
- **Grant preparation will be completed 2-3 Q 2018 to meet the November submission deadline**
- **Study will include:**
  - **Identification of all Bakken potential H_2S Sources**
  - **Evaluation of Best Practices for minimizing H2S at upstream of the well-head**
  - **Evaluation of Best Available SurfaceTreatment Technology (BATT)**
  - **H_2S Geographical mapping**
  - **HSE Recommendations with Best Practices**