

<i>E&B Oilfield Services Inc.</i>	Activity: Pipeline Technition / Pipeline Pigging Hydrogen Sulfide, H2S, Sour Gas		Doc No:	HAZ-ID
			Initial Issue Date	4/1/2015
HAZARD IDENTIFICATION AND ASSESSMENT			Revision Date:	4/1/2016
			Revision No.	1
Preparation: Kayden Kennedy	Authority: Danny Abegglen	Issuing Dept: Safety	Next Revision Date:	4/1/2017
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Purpose

- **Hydrogen Sulfide, H2S, Sour Gas**

Key Responsibilities

- Hydrogen sulfide gas causes a wide range of health effects. Workers are primarily exposed to hydrogen sulfide by breathing it. The effects depend on how much hydrogen sulfide you breathe and for how long. Exposure to very high concentrations can quickly lead to death.
- E&B Management will provide task appropriate meter protection to all employees at risk of job related H2S exposure.
- Supervisors / Leads are required to ensure all employees have H2S protection available.
- E&B Employees are required to have H2S protection at all times. Employees are required to use H2S protection at all times in the field.

Hazard and Risk Identification

- Employees MAY be exposed to dangerous H2S levels during (but is not limited) to the following activities:
 - Blowing down pig launchers
 - In or near oil well locations
 - In or near compressor buildings
 - Any place oil wells or gas lines are in the area

Hydrogen sulfide gas causes a wide range of health effects. Workers are primarily exposed to hydrogen sulfide by breathing it. The effects depend on how much hydrogen sulfide you breathe and for how long. Exposure to very high concentrations can quickly lead to death.

- Hydrogen sulfide is a highly flammable, explosive gas, and can cause possible life-threatening situations if not properly handled. In addition, hydrogen sulfide gas burns and produces other toxic vapors and gases, such as sulfur dioxide.
- In addition to exposure to hydrogen sulfide in the air, exposure to liquid hydrogen sulfide can cause "blue skin" or frostbite. If clothing becomes wet, avoid ignition sources, remove the clothing and isolate it in a safe area to allow it to evaporate.
- The effect called knockdown (rapid unconsciousness) often results in falls that can seriously injure the worker.

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Risk Assessment

Concentration (ppm)	Symptoms/Effects
0.00011-0.00033	Typical background concentrations
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. Airway problems (bronchial constriction) in some asthma patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eye") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death

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E&B OILFIELD SERVICES INC. RISK ASSESSMENT MATRIX - FROSTBITE

CONSEQUENCE					PROBABILITY				
Severity	People	Assets	Environment	Reputation	A	B	C	D	E
					Not Done	Rarely	Once a week	Several Times in a Week	Multiple Times in a Day
0	No health effect	No damage	No effect	No impact					X
1	Slight health effect	Slight damage	Slight effect	Slight impact				X	
2	Minor health effect	Minor damage	Minor effect	Limited impact			X		
3	Major health effect	Localized damage	Localized effect	Considerable impact		X			
4	Single fatality	Major damage	Major effect	National impact	X				
5	Multiple fatalities	Extensive damage	Massive effect	Global impact	X				

Key	Manage for continuous improvement (Low)	Incorporate risk reduction measures (Medium)	Intolerable (High)
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Risk Controls/Methods to Ensure Identified Hazards Are Addressed and Mitigated

The following describes how identified hazards are addressed and mitigated:

- Identify processes that could release or produce hydrogen sulfide. This includes identifying known sources of hydrogen sulfide and evaluating possible fire and explosion hazards. Use a Process or Job Hazard Analysis for identifying and controlling hazards

- Test (monitor) the air for hydrogen sulfide. This must be done by a qualified person. Use the right test equipment, such as an electronic meter that detects hydrogen sulfide gas.

DO NOT rely on your sense of smell, to indicate the continuing presence of hydrogen sulfide or to warn of harmful levels. You can smell the "rotten egg" odor of hydrogen sulfide at low concentrations in air. But after a while, you lose the ability to smell the gas even though it is still present (olfactory fatigue). This loss of smell can happen very rapidly and at high concentrations and the ability to smell the gas can be lost instantly (olfactory paralysis).

- Use exhaust and ventilation systems to reduce hydrogen sulfide levels. Make sure that the system is:
 - Non-sparking
 - Grounded
 - Corrosion-resistant
 - Separate from other exhaust ventilation systems
 - Explosion-proof

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- Train and educate workers about hazards and controls. Training topics may include:
 - Characteristics, sources and health hazards of hydrogen sulfide
 - Symptoms of hydrogen sulfide exposure
 - Types of hydrogen sulfide detection methods and applicable exposure limits
 - Workplace practices and procedures to protect against hydrogen sulfide exposure
 - Emergency plans, locations of safety equipment, rescue techniques, first-aid
 - Confined space procedures
- Use respiratory and other personal protective equipment. If engineering and administrative controls cannot reduce hydrogen sulfide below OSHA's permissible exposure limit, employers must provide respiratory protection and other personal protective equipment (PPE), such as eye protection and possibly fire-resistant clothing. Employers must complete a PPE hazard assessment and equipment selection process in accord with the OSHA regulations before beginning any work activities. Respiratory protection should be at least:
 - For exposures below 100 ppm, use an air-purifying respirator with specialized canisters/cartridges for hydrogen sulfide. A full face respirator will provide eye protection.
 - For exposures at or above 100 ppm, use a full face pressure demand self-contained breathing apparatus (SCBA) with a minimum service life of thirty minutes or a combination full face pressure demand supplied-air respirator with an auxiliary self-contained air supply. Exposures at or above 100 ppm are considered immediately dangerous to life and health (IDLH).

JSA Sample

The following describes how identified hazards are addressed and mitigated:

Basic Job Step	Potential Injury or Hazards	Mitigation / Tools
Blowing down pig launcher/ receiver.	H2S could be present	Stand upwind, wear h2s meter, limit exposure

Other Info

IDLH: immediately dangerous to life and health (level that interferes with the ability to escape) (NIOSH)

PEL: permissible exposure limit (enforceable) (OSHA)

ppm: parts per million

EL: recommended exposure limit (NIOSH)