

	<b>HYDROGEN SULPHIDE (H<sub>2</sub>S)</b> ALL-HSE-PRC-COP-176	Retention Code: <i>CG01</i>
		Revised: <i>February 2014</i>
<b>Owner:</b> <i>HSE Performance Assurance</i>	<b>Approved By:</b> <i>Manager, HSE Performance Assurance</i>	<b>Review Frequency:</b> <i>Five years or less</i>

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## 1.0 Scope

Hydrogen sulphide (H<sub>2</sub>S) is a highly toxic gas. This Hydrogen Sulphide Code of Practice (COP) covers the requirements for working with H<sub>2</sub>S on ConocoPhillips Canada (CPC) locations. All workers must comply with this COP when working on CPC work sites where H<sub>2</sub>S may be present.

## 2.0 Hazards

### 2.1. Potential H<sub>2</sub>S Sources

- Leaks from sour gas wellheads, pipelines, piping, equipment and processes
- Breaking equipment integrity
- Well maintenance
- Pigging
- Uncoupling vent lines and load lines
- Maintenance on equipment without breaking integrity
- Vents or thief hatches on sour liquids storage tanks
- Gauging tanks
- Changing filters
- Entering compressor basements
- Sampling with open or closed containers
- Maintenance on purged equipment
- Flaring sour gas or acid gas
- Entering dikes/firewalls
- General trucking – sour fluids
- Sulphur truck loading with or without degassing

**Note:** The above list contains examples only and is not an exhaustive listing of potential sources.

### 2.2. Physical Properties of H<sub>2</sub>S

- Hydrogen Sulphide is a common contaminant in the upstream oil and gas industry. Hydrocarbons contaminated with H<sub>2</sub>S are commonly called “sour”. The physical properties of H<sub>2</sub>S are as follows:
  - H<sub>2</sub>S is colourless and flammable with a rotten egg smell at low concentrations.
  - H<sub>2</sub>S is generally heavier than air and may collect in low spots.
  - H<sub>2</sub>S and hydrocarbon mixtures may act differently than pure H<sub>2</sub>S. When H<sub>2</sub>S is mixed with some light hydrocarbons (i.e., methane), the mixture can be lighter than air. When mixed with heavier hydrocarbons (i.e., NGL), the mixture is much heavier than air.
  - H<sub>2</sub>S occurs as a vapour or dissolved in produced water, crude oil or natural gas condensate.

- It is possible for H<sub>2</sub>S to collect in confined areas in concentrations exceeding those found in the liquid. Any H<sub>2</sub>S gas that comes out of solution will collect in the headspaces of tanks, pipes and vessels containing sour liquids, liquid sulphur and solid sulphur.
  - For example, the head space of a tank may exceed the occupational exposure limit (OEL) even though it may contain oil with as little as 0.5 parts per million (ppm) H<sub>2</sub>S. In some conditions, the H<sub>2</sub>S concentrations in the headspace may exceed the immediately dangerous to life and health (IDLH) values.
- Hazardous concentrations of H<sub>2</sub>S may also be released by large spills or releases of sour liquids.

### 2.3. Health Effects

Table 1: Health Effects From Inhaling H <sub>2</sub> S	
Less than 1 ppm	You can smell it.
10 ppm	No known adverse health effects for most people.
20 ppm – 50 ppm	Marked eye, nose, throat and lung irritation.
100 ppm – 150 ppm	IDLH = 100 ppm Severe eye, nose, throat and lung irritation. Loss of smell (cannot detect by odour). Exposures of 8 to 48 hours may be fatal.
200 ppm – 300 ppm	Headaches and/or drowsiness. Prolonged exposures of several hours may cause the lungs to fill with fluids.
300 ppm – 500 ppm	May cause unconsciousness and death in 1 to 4 hours.
500 ppm – 700 ppm	Knockdown may be fatal within 1 hour at this level of exposure.
Greater than 700 ppm	Immediate knockdown may be fatal.

*For further information, see Alberta Health Services Acute Exposure Health Effects of Hydrogen Sulphide and Sulphur Dioxide*

## 3.0 Roles and Responsibilities

### 3.1. Supervisors

- Assess area specific hazards and provide adequate respiratory protective and gas detection equipment where the potential for H<sub>2</sub>S exists.
- Ensure all workers are adequately trained and certified in the use of respiratory equipment and gas detection equipment.

### 3.2. Workers

- Be competent in the use and maintenance of gas detection and respiratory protective equipment.
- Check gas detection and respiratory protective equipment prior to use to ensure functionality.
- Use respiratory protective equipment as designed where exposure to H<sub>2</sub>S may occur.

## 4.0 Additional Equipment Requirements

### 4.1. Additional Personal Protective Equipment (PPE) Required

- Appropriate positive pressure respiratory protection [self-contained breathing apparatus (SCBA)/supplied-air breathing apparatus (SABA)].

### 4.2. Additional Equipment Required

- Portable continuous gas detectors as required.

## 5.0 Training

- All workers at ConocoPhillips sites are required to have valid and approved H<sub>2</sub>S training as indicated on the HSE Training Matrix.

## 6.0 Respiratory Protection

**Note:** For detailed information on respiratory protection, refer to the Respiratory Protection Code of Practice.

**Note:** Cartridge-type respiratory masks must not be used for protection in H<sub>2</sub>S environments.

- Respiratory protection is required in the following situations as a minimum:
  - Atmospheric H<sub>2</sub>S concentrations are known to exceed 10 ppm.
  - Atmospheric H<sub>2</sub>S concentrations are unknown.
  - Performing tests to prove H<sub>2</sub>S concentrations using gas detection equipment.
  - When opening a system or process which has the potential to expose workers to H<sub>2</sub>S concentrations above 10 ppm.
- Respiratory protection must be:
  - A full-face, positive pressure SCBA; or
  - A full-face, positive pressure SABA equipped with a 5-minute escape air bottle.
- General respiratory protective equipment requirements:
  - All workers utilizing respiratory protective equipment must be fit tested for the specific respiratory protective equipment being used.
  - Ensure that personnel who may be required to wear respiratory protective equipment are clean-shaven where the seal of the respiratory protective equipment contacts the worker's face.
  - When working on sour drilling and well servicing locations, ensure the minimum number of SCBA units) as required by provincial regulations (two in Alberta, four in British Columbia, two in Saskatchewan) are available on site when a supplied air trailer is not present.

## 7.0 Detection

- H<sub>2</sub>S detection must be conducted with a properly calibrated and function tested detector in accordance with CPC's Gas Detection Safe Operating Practice (SOP) (CPC-ALL-HSE-PRC-SOP-170).

## 8.0 Safe Operating Practice

- Potential H<sub>2</sub>S hazards and mitigation measures, including respiratory protection requirements, must be addressed in hazard assessments, work permits and business unit or site specific operating practices when applicable.
- Workers must check for wind direction, sour gas contamination of the atmosphere and abnormalities regarding the lease and equipment. For detailed information, refer to CPC's Work Site Entry SOP (CPC-ALL-HSE-PRC-SOP-164).

### 8.1. H<sub>2</sub>S Concentrations Between 10 ppm and 100 ppm

**Note:** H<sub>2</sub>S concentrations refer to atmospheric or system concentrations, whichever is greater.

- Positive pressure respiratory protective equipment must be utilized.
- Establish communications with a coworker and discuss the task being completed under respiratory protection
  - Follow-up communication intervals and an emergency response plan must be discussed and agreed upon by all parties. This discussion does not have to be documented.
- Follow any additional guidelines established in hazard assessments, work permits and business unit or site specific operating practices.

### 8.2. H<sub>2</sub>S Concentrations Exceeding 100 ppm

**Note:** H<sub>2</sub>S concentrations refer to atmospheric or system concentrations, whichever is greater.

- Positive pressure respiratory protective equipment must be utilized.
- Backup personnel must be available
- Follow any additional guidelines established in hazard assessments, work permits and business unit or site specific operating practices.

### 8.3. Backup Personnel

- Must be onsite, equipped with respiratory protective equipment and available to immediately respond.
- Must satisfy all H<sub>2</sub>S training and fit testing requirements.
- Backup personnel must also be used when required by hazard assessments, work permits and business unit or site specific operating practices.

**9.0 Signage, Wind Indicators and Product Labels**

- All facilities and sites, where H<sub>2</sub>S is present at or above 10 ppm, must have wind indicators and appropriate signs at the entrance warning of the presence of poisonous gas.
- See applicable product material safety data sheet (MSDS) for appropriate classification and labeling requirements.

**10.0 Transportation of Product Containing H<sub>2</sub>S**

- Must be transported in sealed units and vapours must be appropriately vented while loading and unloading.
- Tank trucks hauling products containing H<sub>2</sub>S must be equipped with breathing apparatus.

**11.0 Iron Sulphide**

- When monitoring for iron sulphide, the following safe work practices shall be considered:
  - Iron sulphide is present in most facilities where hydrogen sulphide and iron come into contact with each other. Iron sulphide will ignite in the presence of air unless it is kept wet. It is not toxic and is found as a brown/black deposit in vessels, tanks, piping, fittings and exchanger bundles.
  - If iron sulphide is present, keep it wet until it can be loaded into proper containers for disposal.
  - In a vessel or system that may contain hydrocarbon vapours and iron sulphide, an inert gas purge may be necessary before admitting air.
  - Verify piping, fittings and controls that have been removed are flushed with water and immediately taken to a safe area where any remaining residue can safely dry out.

**12.0 Document Retention**

Records must be retained in accordance with ConocoPhillips' Document Retention Schedule.

Record	Owner	Classification	Retention
None			

**Appendix A – Revision Record**

Page#	February 28, 2014	Previous Information	Risk Assessment
All	Changed document format.	None.	<b>Low</b> Readability
All	Removed various redundant information and directed workers to applicable SOP or COP for detailed information to eliminate duplication.	Various	<b>Low</b> Readability and redundant information removed
All	Clarified information related to when RPE and backup personnel required.	Various	<b>Low</b> Clarity