



# Hydrogen Sulfide (H<sub>2</sub>S) Protocol

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## 1. ABOUT THIS PROTOCOL

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Purpose	To define what is required to protect workers and the public from the hazards encountered in a Hydrogen Sulfide (H <sub>2</sub> S) environment.
Objective	This protocol establishes safe work practices for personnel managing or working in areas where there is a potential for H <sub>2</sub> S exposure.
Scope	All Devon operations that may be exposed to an environment where H <sub>2</sub> S is present.
Applicability	Devon employees overseeing or working in areas where there is a potential for H <sub>2</sub> S exposure. Contractors will have their own program that meets or exceeds Devon's protocol.
Variations	None.
Superseded Documents	Hydrogen Sulfide Implementation Plan.

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## 3. ROLES

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Division/Business Unit Leadership Reinforce adherence to this protocol and provide resources for application of the protocol. Ensure employees are trained appropriately for working around H<sub>2</sub>S.

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Line Supervisor Understand how this protocol applies to personnel in their area of responsibility. Ensure employees have training, skills, knowledge and understanding to comply with this protocol. Check periodically to ensure the requirements of this protocol are being met.

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Environmental, Health and Safety Provide technical resources and tools for protocol application. Monitor compliance through the audit process.

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Devon Employees Adhere to the requirements of this protocol. Identify and report gaps in this protocol. Complete required training.

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Contract Company Representative Comply with regulatory requirements and follow the Devon EHS protocols.

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## 4. PROTOCOL PREREQUISITES

### 4.1 PROTOCOL OVERVIEW

This Devon Energy EHS Protocol defines what is required to protect workers and the public from the hazards encountered in a H<sub>2</sub>S environment.

### 4.2 APPLICABLE STANDARDS

- American National Standards Institute (ANSI), Standard Z390.1
- American Petroleum Institute (API) RP 49, Recommended Practice for Drilling and Well Service Operations Involving Hydrogen Sulfide
- API RP 55, Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide
- API RP 68, Recommended Practice for Oil and Gas Well Servicing and Workover Operations Involving Hydrogen Sulfide
- National Institute for Occupational Safety and Health, (NIOSH), 77-158, Criteria for a Recommended Standard for Occupational Exposure to Hydrogen Sulfide
- State of New Mexico, Oil Conservation Division – Rule 118
- State of Oklahoma, Oklahoma Corporation Commission – OGR: 3-203.2
- State of Texas, Railroad Commission – Rule 36
- State of Wyoming, Occupational Health and Safety – Chapter 9
- Federal Bureau of Land Management (Onshore Oil and Gas Operations; Federal and Indian Oil and Gas Leases) Onshore Oil and Gas Order No. 6
- Devon Hazard Assessment and Personal Protective Equipment (PPE) Protocol
- Devon Respiratory Protection Protocol
- Devon Emergency Response Plan
- Devon OEL Table
- Devon Pre-Job Planning Protocol

### 4.3 REQUIRED MATERIALS, EQUIPMENT, INFORMATION, OR OTHER RESOURCES

Gas Chromatograph, colorimetric detector tube, electronic detection device (direct reading instrument) or personal/fixed H<sub>2</sub>S monitor for the sampling and/or detection of H<sub>2</sub>S. Respiratory protection equipment as required in the protocol. H<sub>2</sub>S signage as required in the protocol.

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## 5. PROTOCOL

### 5.1 IDENTIFICATION OF H<sub>2</sub>S FACILITIES

Step	Required Action	Role
5.1.1	<p>Determine if a site is an H<sub>2</sub>S facility based on actual or predicted H<sub>2</sub>S concentration.</p> <p><b>Note:</b> Actual H<sub>2</sub>S concentration for production sites will be determined prior to treatment, in the gas or liquid stream for new production or acquired assets by sampling or using measurement gas analysis sample results (internal or third-party gatherer).</p> <p><b>Note:</b> Potential H<sub>2</sub>S concentration for Drilling, Completion and Workover sites will be based on previous sampling data from offset wells and/or rock property analysis (internal or third-party).</p> <p><b>Note:</b> Sampling can be conducted using one of the following methods: Tutwiler test, gas chromatograph, gas analysis, colorimetric detector tubes or by electronic detection devices (direct reading instrument). State and/or agency regulations may require a specific test method.</p> <p><b>Note:</b> Using scavenger to treat the site does not eliminate the need to comply with the monitoring, PPE, signage, etc., requirements identified within the protocol.</p>	Line Supervisor
5.1.2	Create and maintain a list of H <sub>2</sub> S facilities in the area.	Line Supervisor
5.1.3	<p>Calculate the Radius of Exposure (ROE) for sites where the actual or predicted H<sub>2</sub>S concentration is 100 ppm or greater using the Pasquill-Gifford method (see <a href="#">Appendix A</a>).</p> <p><b>Note:</b> ROE calculations for tanks are not required.</p> <p><b>Note:</b> When calculating ROE on pipelines, the calculated distance will run parallel with the pipeline.</p>	EHS / Engineering
5.1.4	<p>Determine if the actual or predicted gas contains a potentially hazardous volume of H<sub>2</sub>S where:</p> <ul style="list-style-type: none"> <li>The 100 ppm ROE is greater than 50 feet and includes any part of a public area except a public road; or</li> </ul>	EHS



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- The 500 ppm ROE is greater than 50 feet and includes any part of a public road; or
- The 100 ppm ROE is greater than 3,000 feet

5.1.5 Classify sites based on the actual or predicted H<sub>2</sub>S concentration. Line Supervisor  
Classifications include:

- ≥10 ppm and <100 ppm
- ≥100 ppm with 100 ppm ROE <50 ft
- ≥100 ppm with 100 ppm ROE >50 ft and <3000 ft and contains no public area or public road
- Any of the following:
  - ≥100 ppm with 100 ppm ROE >50 ft and contains public area
  - ≥100 ppm with 100 ppm ROE >3000 ft
  - ≥500 ppm with 500 ppm ROE > 50 feet and contains public road

## 5.2 H<sub>2</sub>S CONTINGENCY PLANS

Step	Required Action	Role
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5.2.1 Develop an H<sub>2</sub>S Contingency Plan when the actual or predicted gas contains a potentially hazardous volume of H<sub>2</sub>S, as specified in [Appendix B](#).

**Note:** The contingency plan will be available upon request and will be on-site where the plan would be activated and discussed during the pre-task tailgate.

**Note:** Use the H<sub>2</sub>S Contingency Plan template in [Appendix C](#), or equivalent.

5.2.2 Include the following elements within the H<sub>2</sub>S contingency plan: Field EHS

- Emergency procedures
- Characteristics of H<sub>2</sub>S and SO<sub>2</sub>
- Maps and drawings
- Training and drills
- Emergency contacts

**Note:** Use the H<sub>2</sub>S Contingency Plan template found in [Appendix C](#), or equivalent.



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5.2.3 Review and update the H<sub>2</sub>S contingency plan annually, or as needed. Field EHS

**Note:** The review shall include an evaluation of the ROE calculation.

## 5.3 H<sub>2</sub>S HAZARD CONTROLS

Step	Required Action	Role
5.3.1	Implement required controls as specified in <a href="#">Appendix D</a> . <b>Note:</b> Additional federal agency and state regulations may apply. Federal and state regulations can be found on Strata or the hyperlinks in <a href="#">Related Documents - 7.4</a> .	Line Supervisor / Engineering / Employee

## 5.4 COMMUNICATION OF H<sub>2</sub>S HAZARDS

Step	Required Action	Role
5.4.1	Communicate H <sub>2</sub> S facilities and hazards that may be encountered on-site through initial job planning and prior to arriving on location to the following: <ul style="list-style-type: none"> <li>• Employees</li> <li>• Contractors</li> <li>• Visitors</li> </ul> <b>Note:</b> See <a href="#">Appendix E</a> for Chemical Reactivity Hazards which includes special precautions where iron sulfide is present.	Line Supervisor / Employee
5.4.2	Follow state and/or local requirements when posting safety signage to notify employees and contractors of H <sub>2</sub> S. <b>Note:</b> See <a href="#">Appendix F</a> for access to Drilling, Completion and Workover location requirements. <b>Note:</b> See <a href="#">Appendix G</a> for examples of H <sub>2</sub> S signage when a state does not have specific sign requirements and for additional sign requirements.	Line Supervisor / Employee

## 5.5 RESPIRATORY PROTECTION PROGRAM

Wear respiratory protection in accordance with the Respiratory Protection Program. Refer to the [Respiratory Protection Protocol](#) for guidelines concerning facial hair requirements for respirator use.



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Step	Required Action	Role
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5.5.1 Make personal respirators available to essential personnel when required by [Appendix D](#). Employee

**Note:** Essential personnel are those required to provide safe operational activities and those required to affect the control of H<sub>2</sub>S.

5.5.2 Wear an Air Supplying Respirator (ASR) when the concentration of H<sub>2</sub>S in the working atmosphere is above 10 ppm. Employee

5.5.3 Ensure at least one stand-by person is available on site when the H<sub>2</sub>S concentration in the working atmosphere is 100 ppm or greater. The stand-by person must meet the following requirements: Line Supervisor / Employee

- Be equipped with a fully charged Self Continued Breathing Apparatus (SCBA)
- Stationed in a safe location
- Trained in rescue operations
- Able to call for help and aid in an emergency

**Note:** During the pre-task tailgate, the stand-by person will discuss the job steps and determine the appropriate egress during emergency evacuations. A rescue team will be required when appropriate egress routes are not provided with adequate walking/working surfaces. If proper means of egress cannot be achieved during emergency evacuation of the area, a rescue team will be required.

5.5.4 Evacuate the area by immediately moving upwind and crosswind if a personal or fixed monitor alarms, or you begin to feel effects of exposure. Employee

## 5.6 PERSONAL AND FIXED H<sub>2</sub>S MONITORS

Manufacturers' recommendations will be followed for the installation, maintenance, calibration and repair of equipment.

Step	Required Action	Role
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5.6.1 Wear a personal four-gas monitor in the breathing zone when required by the [Hazard Assessment and Personal Protective Equipment \(PPE\) Protocol](#). Employee

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**Note:** Drilling and completion (stimulation only) specific sites with fixed LEL monitoring are exempt from the requirement for personal four-gas monitors and will wear personal H<sub>2</sub>S monitors when required by [Appendix D](#).

**Note:** All employees, contractors and visitors are expected to comply with this requirement.

5.6.2 Ensure H<sub>2</sub>S alarm set point for personal monitors are set at 10 ppm. Line Supervisor

5.6.3 Install fixed H<sub>2</sub>S monitors when required by [Appendix D](#). Consider the following to determine if fixed monitors should be installed when they are not otherwise required:

- Concentration of H<sub>2</sub>S in gas/liquid stream or working atmosphere
- Volume and/or pressure of the H<sub>2</sub>S gas or liquid in system
- Operations involving enclosed facilities with processing equipment containing H<sub>2</sub>S
- Exposure potential for employees (manned vs. unmanned facility)
- Exposure potential for the public (populated vs. remote area)
- Response time to a release

When required, fixed H<sub>2</sub>S monitors will be placed around the sites at the following locations:

Drilling	Completion/Workover	Production
Rig floor	Open hole near wellbore	Enclosed buildings
Cellar	Well fluids surface pit	Inadequately ventilated areas
Bell nipple		
Possum belly/shakers		
Choke manifold		

5.6.4 Fixed H<sub>2</sub>S monitors shall be designed, installed and operated to meet the following minimum criteria: Electrical / Line Supervisor

- Provide early detection and allow proper response to protect personnel and the public
- Equipped with visual and audible alarms
- Located where the alarm can be seen or heard throughout the work area



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- Always maintained in operational status (Superintendent approval is required any time the monitor is bypassed or un-operational)
- Equipment must be UL listed and intrinsically safe

5.6.5 Fixed H<sub>2</sub>S monitors will have a low-level alarm set at 10 ppm and the high-level alarm established by the site’s risk assessment, which is not to exceed 100 ppm. Line Supervisor

## 5.7 OPENING EQUIPMENT/ENTERING BUILDINGS CONTAINING H<sub>2</sub>S

Precautions shall be taken prior to any operations involving the opening of equipment (including tanks, vessels, lines, valves, well heads, etc.) to atmosphere where H<sub>2</sub>S is known or suspected to be present or when entering buildings containing equipment where H<sub>2</sub>S is present in the gas stream or gas phase above produced fluids.

Step	Required Action	Role
5.7.1	Protect personnel from exposure to H <sub>2</sub> S prior to opening equipment containing H <sub>2</sub> S greater than 10 ppm in the gas stream or gas phase above produced fluids by using the following methods: <ul style="list-style-type: none"> <li>• Use portable H<sub>2</sub>S detection equipment to test the working atmosphere before opening and continuously while working</li> <li>• H<sub>2</sub>S concentration in the working atmosphere must remain less than 10 ppm to continue without the use of respiratory protection</li> <li>• ASR must be donned if portable H<sub>2</sub>S detection equipment indicates the presence of 10 ppm or greater concentration of H<sub>2</sub>S in the working atmosphere</li> <li>• H<sub>2</sub>S concentration in the working atmosphere must remain less than 100 ppm to continue without standby person</li> <li>• Respiratory protection may be removed only after portable H<sub>2</sub>S detection equipment indicates concentration of H<sub>2</sub>S in the working atmosphere is less than 10 ppm</li> </ul>	Line Supervisor / Employee
5.7.2	Protect personnel from exposure to H <sub>2</sub> S prior to opening equipment containing H <sub>2</sub> S greater than 100 ppm in the gas stream or gas phase above produced fluids by using the following methods: <ul style="list-style-type: none"> <li>• Review and utilize the area specific Job Hazard Analysis (JHA)</li> <li>• Notify the Line Supervisor prior to opening equipment to review the job steps</li> </ul>	Line Supervisor / Employee

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- Use portable H<sub>2</sub>S detection equipment to test the working atmosphere before opening and continuously while working
- H<sub>2</sub>S concentration in the working atmosphere must remain less than 10 ppm to continue without the use of respiratory protection
- ASR must be donned if portable H<sub>2</sub>S detection equipment indicates the presence of 10 ppm or greater concentration of H<sub>2</sub>S in the working atmosphere
- H<sub>2</sub>S concentration in the working atmosphere must remain less than 100 ppm to continue without standby person
- Respiratory protection may be removed only after portable H<sub>2</sub>S detection equipment indicates concentration of H<sub>2</sub>S in the working atmosphere is less than 10 ppm

5.7.3 Protect personnel from exposure to H<sub>2</sub>S prior to entering buildings, pump rooms or similar areas where H<sub>2</sub>S is greater than 100 ppm in the gas stream of gas phase above produced fluids by using one or more of the following methods:

- Use portable H<sub>2</sub>S detection equipment to test the working atmosphere within the enclosure before entry and continuously while within the enclosure; or
- Use fixed H<sub>2</sub>S monitoring that provides audible and/or visible warning; or
- Use ventilation (e.g., designed to maintain concentrations below 10 ppm), which will be confirmed through fixed monitoring detection system; or
- Wear an ASR before entering and while within the enclosure

**Note:** The following apply for the duration of work:

- H<sub>2</sub>S concentration in the working atmosphere must remain less than 10 ppm to continue without the use of respiratory protection
- ASR must be donned if portable H<sub>2</sub>S detection equipment indicates the presence of 10 ppm or greater concentration of H<sub>2</sub>S in the working atmosphere
- H<sub>2</sub>S concentration in the working atmosphere must remain less than 100 ppm to continue without standby person
- Respiratory protection may be removed only after portable H<sub>2</sub>S detection equipment indicates concentration of H<sub>2</sub>S in the working atmosphere is less than 10 ppm



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## 5.8 SAMPLING/TREATMENT OF H<sub>2</sub>S FACILITIES

Step	Required Action	Role
5.8.1	At H <sub>2</sub> S facilities, sample the vapor space of one tank of each type (e.g., produced water tank, condensate tank, oil tank, etc.). <b>Note:</b> If H <sub>2</sub> S concentration in the working atmosphere is 10 ppm or greater, supplied air must be used.	Line Supervisor
5.8.2	Conduct additional H <sub>2</sub> S sampling according to the sample frequency in <a href="#">Appendix H</a> , as processes change or as conditions warrant at field locations where H <sub>2</sub> S is known or suspected. <b>Note:</b> Where allowed by state regulations, a representative sample may be used.	Line Supervisor
5.8.3	Record the sample results. <b>Note:</b> Follow state sampling requirements where they exist. If no state sampling requirements exist, sample as necessary to obtain the maximum H <sub>2</sub> S concentration.	Line Supervisor
5.8.4	Treat equipment containing bacterial H <sub>2</sub> S with appropriate material (e.g., scavenger, etc.) until levels remain less than 10 ppm. <b>Note:</b> Bacterial H <sub>2</sub> S does not constitute the site to be identified as an H <sub>2</sub> S Facility however appropriate signage is required.	Line Supervisor

## 5.9 EMERGENCY PREPAREDNESS, RESPONSE AND RESCUE

Step	Required Action	Role
5.9.1	Areas that have sites with H <sub>2</sub> S concentration of 100 ppm or more in the untreated gas stream shall include specific actions relating to H <sub>2</sub> S emergencies (e.g., responding to releases, addressing emergency response and rescue, etc.) in their <a href="#">Emergency Response Plan</a> .	Line Supervisor



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**Note:** This plan will include a section verifying the following requirements regardless of whether the rescue team is internal/contract:

- Training specific to H<sub>2</sub>S
- Location and proper inspection of SCBA's
- Emergency responder requirements
- Proper personal monitoring

5.9.2 If the audible alarm sounds while on a Devon facility and/or right-of-way from either a personal or fixed monitor: Employee

- Notify any other personnel in the immediate area
- Evacuate the area by immediately moving upwind and crosswind
- Notify the immediate Supervisor and local EHS

5.9.3 Prior to re-entry, use the following methods when testing a facility after a personal or fixed H<sub>2</sub>S monitor alarms prior to re-entry: Line Supervisor

- Develop a JHA that defines the re-entry process and verification that the H<sub>2</sub>S concentration is less than 10 ppm
- For sites with known H<sub>2</sub>S concentration of less than 100 ppm in the gas stream or gas phase above produced fluids, test while wearing an ASR
- For sites with known H<sub>2</sub>S concentration of 100 ppm or greater in the gas stream or gas phase above produced fluids, test while wearing an ASR and have a stand-by person

**Note:** The JHA must be approved by the local Superintendent.

5.9.4 Do not re-enter the area without supplied air until the area has been tested and is found to have H<sub>2</sub>S concentration less than 10 ppm. Employee

5.9.5 Prior to performing stand-by duties, verify the SCBA is fully charged and working properly, then don the SCBA prior to entering the area. Employee / Emergency Response Personnel

**Note:** Emergency escape packs must never be used for rescue; they are only intended for escape purposes.

5.9.6 If the stand-by person responds to an unconscious individual, they are responsible for calling in the Emergency Response Team prior to entering the area. Perform rescue and remove unconscious individual to a safe location, if it is safe to do so. Employee / Emergency Response Personnel



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5.9.7	If the stand-by person is unsuccessful removing the unconscious employee, the stand-by person will provide lifesaving support (e.g., ensure the patient’s airline is not kinked, facemask is secured on the patient’s face, etc.) until the Emergency Response Team arrives.	Employee / Emergency Response Personnel
5.9.8	Stop rescue and leave the area immediately if: <ul style="list-style-type: none"> <li>The conditions become unsafe</li> <li>There is a failure with the SCBA, or it alarms</li> <li>The rescue cannot be performed safely</li> </ul>	Employee / Emergency Response Personnel
5.9.9	Perform first aid and/or Cardiopulmonary Resuscitation (CPR) as needed, if trained to do so.  <b>Note:</b> Mouth-to-mouth on an exposed individual can lead to secondary H <sub>2</sub> S exposure.	Employee / Emergency Response Personnel
5.9.10	Activate the site H <sub>2</sub> S Contingency Plan if required.	Employee

## 5.10 REGULATORY PERMITTING / AGENCY NOTIFICATIONS

Step	Required Action	Role
5.10.1	Obtain any necessary permits that may be required to operate H <sub>2</sub> S facilities, or drill in a zone with H <sub>2</sub> S. If required, permits must be in place prior to beginning operations.	Line Supervisor
5.10.2	Notify the Environmental Department 60 days prior to construction for state-specific air permitting evaluations. Some states may require that an air permit be submitted, and authorization received prior to construction.	Line Supervisor
5.10.3	Notify State/Federal agencies, where required, of any accidental release of H <sub>2</sub> S of sufficient volume to present a hazard and for any H <sub>2</sub> S related accident.	Field EHS

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## 6. TERMS AND DEFINITIONS

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**Air Supplying Respirator (ASR)** A device that provides Grade D breathing air. There are two types of ASR: Supplied Air Respirator (SAR) and Self-Contained Breathing Apparatus (SCBA).

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**Area of Exposure** An area within a circle constructed with the point of release as its center and a radius equal to the distance calculated in the ROE.

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**Breathing Zone** For the employee, the hemisphere in front of the shoulders with a radius from the nose/mouth of 6-9 inches.

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**Building** A structure with four sides and a roof (e.g., meter houses, compressor buildings, etc.).

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**Colorimetric Detector Tube** Glass vials filled with a chemical reagent that reacts to a specific chemical or family of chemicals, such as H<sub>2</sub>S. A sample of air is drawn through the tube with a bellows pump that can be hand operated or electric. If the targeted chemical is present in the air being sampled, the reagent in the tube changes color and the length of the color change indicates the measured concentration of the material in the air (± 25%).

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**Contingency Plan** A written document that contains emergency response procedures which provide an organized plan of action for alerting and protecting the public within an area of exposure following an accidental release of a potentially hazardous volume of H<sub>2</sub>S.

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**Escape Pack** An emergency escape-breathing device providing 5, 10 or 15 minutes of breathing for escape from toxic environments, even in concentrations IDLH.

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**Grain (one grain 100 ft<sup>3</sup> of gas)** A unit of measure for H<sub>2</sub>S and is expressed in the following manner:  
 Grains per 100 cubic feet  
 ¼ grain = 4 ppm  
 1 grain = 16 ppm

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**Hydrogen Sulfide (H<sub>2</sub>S)** Toxic, highly flammable, colorless gas formed in nature by the decomposition of organic material by bacteria. H<sub>2</sub>S is found in natural gas, oil, sewers,

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# Hydrogen Sulfide (H<sub>2</sub>S) Protocol

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stagnant water, volcanic gases, sulfur springs and anywhere that organic materials may be broken down.

**Hydrogen Sulfide (H<sub>2</sub>S) Facility** Any location where H<sub>2</sub>S concentration of 10 ppm or greater exist before treatment (oil, gas, water or stream), however; this does NOT include sites impacted by bacterial H<sub>2</sub>S.

**Immediately Dangerous to Life or Health (IDLH)** Exposure to airborne contaminants that is likely to cause death or may cause immediate or delayed permanent adverse health effects that might prevent escape from such an environment. For H<sub>2</sub>S, this concentration is 100 ppm per the [OEL Table](#).

**Incident Management Team (IMT)** Group of people assigned to manage an incident under the incident command system. Within Devon, IMTs exist at three levels – local (site), division (DIMT) and corporate (CIMT).

**Iron Sulfide** Chemical compound consisting of iron and sulfur, commonly found inside piping, vessels and/or other equipment where H<sub>2</sub>S is or has been present, that will ignite and burn in the presence of oxygen in air.

**National Association of Corrosion Engineers (NACE)** A professional organization for the corrosion control industry established in 1943. The focus of their activities includes cathodic protection, coatings for industry and material selection for specific chemical resistance.

**Parts Per Million (ppm)** A concentration by volume of one part of a gas (or vapor), or by weight of a liquid or solid, per million parts of air or liquid.

**Potentially Hazardous Volume of Hydrogen Sulfide (H<sub>2</sub>S)** A volume of H<sub>2</sub>S gas of such concentration that:

- The 100 ppm ROE is in excess of 50 feet and includes any part of a public area except a public road; or
- The 500 ppm ROE is greater than 50 feet and includes any part of a public road; or
- The 100 ppm ROE is greater than 3,000 feet

**Pressure Demand Respirator** A respirator equipped with a full-face piece in which positive pressure is maintained in the face piece during both inhalation and exhalation.



# Hydrogen Sulfide (H<sub>2</sub>S) Protocol

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Public Area	A dwelling, place of business, church, school, hospital, school bus stop, government building, a public road, all or any portion of a park, city, town, village or other similar area that can be expected to be populated.
Public Road	Any federal, state, county or municipal street or road owned or maintained for public access or use.
Radius of Exposure (ROE)	The distance from a release to where H <sub>2</sub> S concentration in the air will dilute to a specific concentration.
Respirator	Any device designed to provide the wearer with respiratory protection against inhalation of hazardous atmosphere.
Self-Contained Breathing Apparatus (SCBA)	A respirator that has breathing air carried in a tank on the worker's back and supplied through a hose into a full-face respirator with a minimum cylinder rating of 30 minutes under positive pressure/pressure demand.
Sulfur Dioxide (SO <sub>2</sub> )	A toxic gas created when H <sub>2</sub> S is burned. It is heavier than air and forms sulfuric acid when combined with moisture (including perspiration).
Supplied Air Respirator (SAR)	A respirator that has compressed air from a stationary source and is supplied through a high-pressure hose connected to a full-face respirator under positive pressure/pressure demand with an auxiliary self-contained bottle (rated for a minimum of 5 minutes).
Tutwiler Test	A field test for determining H <sub>2</sub> S in gas mixtures. Mercaptan sulfur and carbonyl sulfide, if present, are determined as H <sub>2</sub> S. The accuracy of this method is not sufficient to obtain reliable results below 5 grains of H <sub>2</sub> S per 100 ft <sup>3</sup> .
Working Atmosphere	The area surrounding a worker that possess a respiratory exposure.

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## General Terms and Definitions

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Area	Individual operating fields or components that collectively comprise a region. Areas normally include an area office.
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# Hydrogen Sulfide (H<sub>2</sub>S) Protocol

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Area Office	A field office with assigned employees that support an area (e.g., Artesia, Cuero, etc.).
Business Unit	Individual components that collectively comprise the U.S. Division. Business Units may also be referred to as Basins.
Contract Company Representative	A contractor who is assigned responsibilities and oversight for a specific task that requires adherence to Devon EHS Protocols.
Division	The division operations of Devon are Corporate, Strategic-Services, Facilities and Pipeline and U.S.
Enterprise Classification Structure (ECS)	Part of Devon’s strategic plan for managing information assets. The ECS is the published list of all records classes, the period for retaining each and their designated disposition.
Field EHS	A titled position that provides EHS guidance and supports field operations.
Facility	A collection of structures, piping, valves, vessels, tanks, compression and processing equipment located in close geographic proximity, that are involved directly in the development, production, processing or delivery of oil and gas to market (e.g., a tank battery, drill-site, well-site, compressor station, pipeline, gas plant, etc.).
Line Supervisor	A titled position that has assigned authority and responsibility for financials, production, maintenance, projects and personnel for a defined area. In Devon, this could be any Supervisor, Superintendent, Foreman or Assistant Foreman.
Person in Charge (PIC)	A person that has been authorized by Devon to perform specific tasks to comply with this Devon protocol and/or regulatory requirements related to EHS.
Region / District	Individual components that collectively compromise a division.

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## 7. DOCUMENT MANAGEMENT

### 7.1 REVISION DETAILS

The following changes were made to this Protocol during the latest revision:

Section	Changes Made	Reasons for Change
<b>Reference sections from previous version of Protocol:</b>		
5.1	Removed 'Communication' portion from section and placed in new section 5.4.	Improve protocol understanding.
5.1.4 & 5.3.3	Removed requirement to sample tanks when levels are 500 ppm or below.	Sampling is required at H <sub>2</sub> S facilities and signs are required at concentration more stringent than state requirements.
5.1.4 & 5.3.3	Removed 'unknown' from language in note.	Eliminate confusion about what an unknown concentration is.
5.2 & 5.3	Combined 'Drilling, Workover and Completion Safe Work Practices' with 'Operation Safe Work Practices' and placed in new section 5.3.	Improve protocol understanding.
5.4.7	Removed ambu bag language.	Current first aid kits do not include ambu bag.
6.0	Removed ambu bag definition.	Removed ambu bag from protocol.
8.1.4	Removed H <sub>2</sub> S Contingency Plan training line item.	Current H <sub>2</sub> S Operations level training covers contingency planning.
Appendix – H <sub>2</sub> S Compliance Requirements	Removed column for stock tank vapor space greater than 500 ppm.	Covered in other steps of the protocol.
Appendix – H <sub>2</sub> S Compliance Requirements	Removed 'flare gun' in flare stacks provision of the Drilling, Completions and Workover table.	Flare guns are not used for lighting the flare.
Appendix – H <sub>2</sub> S Compliance Requirements	Removed API reference in materials provision of both tables.	API reference is for offshore Operations.
Appendix – H <sub>2</sub> S Compliance Requirements	Removed control and equipment safety provision in both tables.	Covered by other steps in the protocol.



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Appendix – H <sub>2</sub> S Compliance Requirements	Removed agency notification provision in both tables.	Covered by another step in the protocol.
Appendix – H <sub>2</sub> S Compliance Requirements	Removed Gas Plant table.	There are no current gas plants.
Appendix – H <sub>2</sub> S Warning Signs Section One	Removed language for caution and danger signs and referenced the sign Appendix.	Align with protocol requirements.
Appendix – Federal and State Requirements	Removed Appendix with links to the Federal and State requirements.	Links are provided in section 7.4.
Attachment – H <sub>2</sub> S Sample Results Form	Removed H <sub>2</sub> S sample forms from protocol.	Allow areas to use area specific forms.
Attachment – H <sub>2</sub> S Facilities List	Removed H <sub>2</sub> S facilities list attachment form from protocol.	Allow areas to maintain H <sub>2</sub> S facilities list how they choose.
<b>Reference sections for this version of the Protocol:</b>		
All	Removed duplicity throughout protocol.	Improve protocol understanding.
Multiple	Rearranged/modified sections and steps throughout protocol.	Improve protocol understanding.
5.1, 5.2	Added language to determine H <sub>2</sub> S facility by actual or predicted concentration.	Clarify how to determine H <sub>2</sub> S concentration for different Operations.
5.1.4	Added step to determine if gas contains a potentially hazardous volume of H <sub>2</sub> S.	Identify facilities with a potentially hazardous volume of H <sub>2</sub> S.
5.1.5	Added step to classify sites based on H <sub>2</sub> S concentration.	Set up step for H <sub>2</sub> S Control Requirements Appendix.
5.2.2	Updated contingency plan element requirements.	Align with state requirements.
5.2.3	Added note that the review shall include evaluation of the ROE calculation.	Ensure ROE calculation is updated as necessary.
5.4	Created new section ‘Communication of H <sub>2</sub> S Hazards’ and moved applicable language to section.	Improve protocol understanding.
5.4.2	Added notes to reference Access to Drilling, Completion and Workover location requirements and H <sub>2</sub> S signage.	The previous Appendix was divided into two sections.



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5.5	Created new section 'Respiratory Protection Program' and moved applicable language to section.	Improve protocol understanding.
5.5.1	Modified language to make personal respirators available to essential personnel.	Clarify personal respirators are not required at all H <sub>2</sub> S facilities.
5.6	Created new section 'Personal and Fixed H <sub>2</sub> S Monitors' and moved applicable language to section.	Improve protocol understanding.
5.6.1	Added language specifying four-gas monitor and a note for personal H <sub>2</sub> S monitors.	Align with the Hazard Assessment and PPE protocol.
5.6.3	Added table for fixed H <sub>2</sub> S monitor placement and added production locations.	Clarify where fixed H <sub>2</sub> S monitors will be placed when required.
5.7	Created new section 'Opening Equipment/Entering Buildings Containing H <sub>2</sub> S' and moved applicable language to section.	Improve protocol understanding.
5.7.1, 5.7.2	Added steps for opening equipment containing H <sub>2</sub> S.	Explain requirements for opening equipment containing H <sub>2</sub> S.
5.8	Created new section 'Sampling/Treatment of H <sub>2</sub> S Facilities' and moved applicable language to section.	Improve protocol understanding.
5.8.2	Added language to reference sample frequency Appendix for additional sampling requirements.	List requirements for additional sampling frequency.
5.9.3	Added language for re-entry testing requirements at sites with known H <sub>2</sub> S concentration less than 100 ppm and sites with known H <sub>2</sub> S concentration 100 ppm or greater.	Allow re-entry testing at sites with known H <sub>2</sub> S concentration less than 100 ppm to be performed without stand-by personnel.
6.0	Added the following definitions: area of exposure, breathing zone, colorimetric detector tube, potentially hazardous volume of H <sub>2</sub> S, pressure demand respirator and respirator.	Define terms added to protocol requirements or that were not included previously.



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6.0	Removed 'prior to intentional' from contingency plan definition.	Match protocol language that contingency plan is for an accidental release of H <sub>2</sub> S.
8.1.1	Modified H <sub>2</sub> S concentration for Awareness level training from greater than 10 ppm to may reach 10 ppm.	Require H <sub>2</sub> S Awareness training for those working or visiting facilities where H <sub>2</sub> S may reach 10 ppm.
8.1.1	Added note that training for visitors may be waived under certain conditions.	Allow waiver for certain circumstances.
8.1.2	Added 'Operations' to required action.	Clarify annual H <sub>2</sub> S training is Operations training.
8.1.3	Replaced 'emergency response' with 'H <sub>2</sub> S Rescue'.	Align with current LMS training.
Appendices	Rearranged/modified appendices in protocol.	Improve protocol understanding.
Appendix – H <sub>2</sub> S Contingency Plan Flowchart	Modified Appendix to include all Operations and created a new flowchart.	Previous flowchart was only applicable to Production Operations.
Appendix – H <sub>2</sub> S Control Requirements	Added additional examples of controls.	Consideration of all types of controls.
Appendix – H <sub>2</sub> S Control Requirements	Added column for H <sub>2</sub> S facilities between 10 and 100 ppm.	Provide a table where all control requirements can be identified for H <sub>2</sub> S facilities.
Appendix – H <sub>2</sub> S Control Requirements	Transferred language from previous version of protocol steps and placed into applicable provisions.	Improve protocol understanding.
Appendix – H <sub>2</sub> S Control Requirements	Modified JHA provision requirement in both tables from 100 ppm in the working atmosphere to 100 ppm.	Require JHA when H <sub>2</sub> S concentration is 100 ppm or greater in the gas stream.
Appendix – H <sub>2</sub> S Control Requirements	Modified H <sub>2</sub> S concentration requirement for wind indicator provision in both tables from 100 ppm to 10 ppm.	Require wind indicators at facilities with 10 ppm or greater H <sub>2</sub> S concentration.
Appendix – H <sub>2</sub> S Control Requirements	Modified number of exits for the enclosed buildings provision in the Production Operations table.	Allow small buildings with no space for multiple doors.
Appendix – Drilling, Completion and Workover Access to Location	Created new Appendix and moved applicable language to Appendix.	Hazard conditions include more than just signage.



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Appendix – Drilling, Completion and Workover Access to Location	Added ‘No Hazard Condition’ requirements to Appendix.	Clarify conditions with less than 10 ppm H <sub>2</sub> S.
Appendix – Drilling, Completion and Workover Access to Location	Changed ‘operator representative’ to ‘PIC’ and ‘community warning and protection’ to ‘H <sub>2</sub> S Contingency’ in conditions I, II and III.	Align with protocol requirements.
Appendix – H <sub>2</sub> S Signage	Replaced ‘access roads’ with ‘entrance points and/or roads which provide direct access’.	Clarify the type of roads.
Appendix – H <sub>2</sub> S Signage	Added additional Danger sign conditions from previous protocol language.	Improve protocol understanding.
Appendix – H <sub>2</sub> S Sampling Frequency	Created new Appendix for sampling frequency.	Identify requirements for sample frequency.
Appendix – H <sub>2</sub> S Training Requirements	Updated Appendix with training requirements from protocol and current LMS courses.	Align with protocol and LMS courses.

## 7.2 APPROVAL

This procedure has been approved by:

Name	Title
Garrett Jackson	VP, EHS

## 7.3 SEEKING AND APPROVING VARIANCES

Variations to this document will be submitted in accordance with the EHS Document Control and Records Management Protocol.

## 7.4 RELATED DOCUMENTS

Document Name
<a href="#">Devon Hazard Assessment and Personal Protective Equipment (PPE) Protocol</a>
<a href="#">Devon Respiratory Protection Protocol</a>
<a href="#">Devon Emergency Response Plan</a>
<a href="#">Devon OEL Table</a>
<a href="#">Devon Pre-Job Planning Protocol</a>



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[Radius of Exposure Calculation Sheet](#)

[Federal Bureau of Land Management Onshore Oil and Gas Order No. 6](#)

[State of New Mexico, Oil and Gas Conservation Division - Rule 118](#)

[State of Oklahoma, Oklahoma Corporation Commission - OGR: 3-230.2](#)

[State of Texas, Railroad Commission - Rule 36](#)

[State of Wyoming, Occupational Health and Safety - Chapter 9](#)

[EHS Template Hydrogen Sulfide Field Contingency Plan](#)

[EHS Template Hydrogen Sulfide Drilling Contingency Plan](#)

[Approval, Review and Modification History](#)

## 7.5 CITED DOCUMENTS

Reference #	Citation or Source
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## 8. ADDITIONAL RELATED INFORMATION

### 8.1 TRAINING AND CERTIFICATION REQUIREMENTS

Step	Required Action	Role
8.1.1	Provide H <sub>2</sub> S Awareness training for all Devon employees working or visiting facilities where measured levels of H <sub>2</sub> S may reach 10 ppm. <b>Note:</b> See <a href="#">Appendix I</a> for H <sub>2</sub> S training requirements. <b>Note:</b> Training for visitors may be waived if operations are considered normal and the visitors are continuously escorted by a H <sub>2</sub> S trained employee.	Line Supervisor / Field EHS
8.1.2	Provide annual H <sub>2</sub> S Operations training to employees working in or around H <sub>2</sub> S facilities (greater than or equal to 10 ppm). <b>Note:</b> See <a href="#">Appendix I</a> for H <sub>2</sub> S training requirements.	Line Supervisor / Field EHS
8.1.3	Provide H <sub>2</sub> S Rescue training to employees who are designated to perform rescue or stand-by person duties. <b>Note:</b> See <a href="#">Appendix I</a> for H <sub>2</sub> S training requirements.	Line Supervisor / Field EHS
8.1.4	Notify contractors working in H <sub>2</sub> S areas that they must have completed required regulatory training that meets or exceeds Devon's minimum requirements.	Line Supervisor / Field EHS

### 8.2 RECORDS/LOGS/REPORTS

Step	Required Action	Role
8.2.1	Forward all H <sub>2</sub> S records listed below to Line Supervisor for filing.	Employee / Contract Company Representative
8.2.2	File the records as noted below:	Line Supervisor



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Record	File Location & Number	Retention Period	Enterprise Classification Code
H <sub>2</sub> S Contingency Plan	See Field Office File Directory	CY + 3 CY = Current Year	EH45
ROE Calculations	See Field Office File Directory	CY + 3 CY = Current Year	EH45
H <sub>2</sub> S Facilities List	See Field Office File Directory	CY + 3 CY = Current Year	EH45
Sample Results Form	See Field Office File Directory	CY + 3 CY = Current Year	EH45

**Note:** The Records Management Enterprise Classification Structure Code is listed as a reference, which should be used when records are sent to stored records.



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## APPENDIX A: H<sub>2</sub>S RADIUS OF EXPOSURE CALCULATION

Ambient Temperature: 60 F

Atmospheric Pressure: 14.65 (Normally 14.65)

Gas Volume, Q: 1,000 cft<sup>3</sup>

ppm H<sub>2</sub>S: 1,300 ppm

Q – “Q” in the equation is the escape rate for a system or facility expressed in cubic feet per day. Q for a gas well will either be the well’s adjusted open-flow potential, or if you feel that it is too high, your estimate of the well’s capacity to flow against zero back-pressure. Q is corrected to standard temperature and pressure.

For the 500 ppm Radius of Exposure:

$$X = [(0.4546)(\text{H}_2\text{S mole fraction})(\text{Rate of Escape, Q})]^{0.6258}$$

X= 55 feet

For the 100 ppm Radius of Exposure:

$$X = [(1.589)(\text{H}_2\text{S mole fraction})(\text{Rate of Escape, Q})]^{0.6258}$$

X= 119 feet

[Radius of Exposure Calculation Sheet](#)

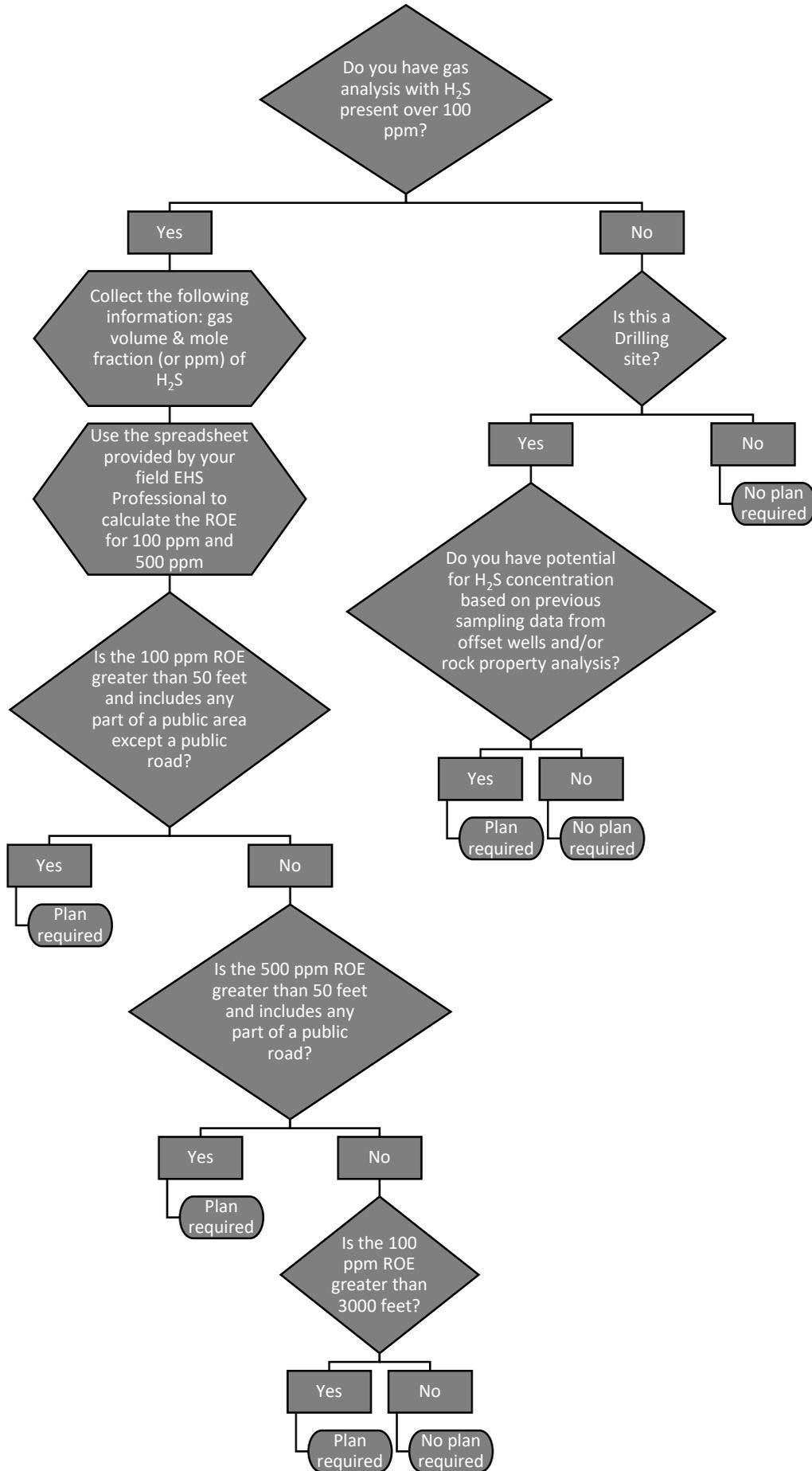
H<sub>2</sub>S mole fraction is concentration of H<sub>2</sub>S in ppm divided by 1 million.

Escape rate is expressed in cubic feet per day (corrected for standard conditions of 14.65 psia and 60 F).

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## APPENDIX B: H<sub>2</sub>S CONTINGENCY PLAN FLOWCHART

Determine the need for a H<sub>2</sub>S Contingency Plan. If the state has more stringent requirements, follow the state requirements for developing a contingency plan.





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### APPENDIX C: H<sub>2</sub>S CONTINGENCY PLAN TEMPLATES

Use the hyperlink below to find an example of an H<sub>2</sub>S Contingency Plan.

[EHS Template Hydrogen Sulfide Field Contingency Plan](#)

[EHS Template Hydrogen Sulfide Drilling Contingency Plan](#)



## Hydrogen Sulfide (H<sub>2</sub>S) Protocol

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### APPENDIX D: H<sub>2</sub>S CONTROL REQUIREMENTS

Engineering controls should be the first line of protection against H<sub>2</sub>S hazards. Administrative controls will be implemented to minimize the exposure to H<sub>2</sub>S hazards that cannot be mitigated through engineering controls. PPE should be used as a last line of defense when engineering and/or administrative controls cannot provide sufficient protection.

Examples of controls to consider based on risk include:

- Killing the well during drilling, completions or workover
- External or remote tank gauges
- Re-piping tank equalizing/switching valves to ground level
- Closed drain or vent systems
- Chemical treating
- Vapor Recovery Unit (VRU)
- SCADA systems
- Training
- SCBA



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<b>Drilling, Completion and Workover</b>				
If the predicted H <sub>2</sub> S concentration could exceed listed levels, implement required controls.				
Provision	≥10 ppm and <100 ppm	≥100 ppm with 100 ppm ROE <50 ft	≥100 ppm with 100 ppm ROE >50 ft and <3000 ft and contains no public area or public road	≥100 ppm with 100 ppm ROE >50 ft and contains public area, ≥100 ppm with 100 ppm ROE >3000 ft, ≥500 ppm with 500 ppm ROE >50 feet and contains public road
Flare Stacks – install a choke manifold, mud-gas separator and provide a suitable method for lighting the flare. Use an automatic ignition source or ignition system to light the stack.			X	X
Drill Stem Tests – permitted only during daylight hours.			X	X
BOP – BOP test will be done nearest to the bit change prior to reaching compliance depth. Secondary remote control of blowout prevention and choke equipment to be located away from the rig floor at a safe distance from the wellhead.			X	X
Materials – must meet requirements of NACE MR0175			X	X
Job Hazard Analysis (JHA) – conduct a JHA before beginning tasks that are non-routine (as defined in the <a href="#">Pre-Job Planning Protocol</a> ) or activities that are without a procedure. The JHA must include respiratory precautions and a stand-by person.		X	X	X
Evacuation Plan – establish an evacuation plan during the pre-task tailgate when working at H <sub>2</sub> S facilities that includes communicating wind	X	X	X	X



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direction (e.g., wind indicators on location) and identifying muster areas and emergency exits.				
Warning and Marker Provision - refer to <a href="#">Appendix E</a> .	X	X	X	X
Wind Indicators – will be installed at strategic locations at or near the site, be readily visible from any location on site, placed where wind movement is unobstructed and be elevated and rotate freely.	X	X	X	X
Signs –refer to <a href="#">Appendix G</a> .	X	X	X	X
Contingency Plan – an organized plan of action for alerting and protecting the public following an accidental release of a potentially hazardous volume of H <sub>2</sub> S.				X
Training – Refer to <a href="#">Appendix I</a> .	X	X	X	X
Monitoring Equipment – personal and fixed detection and alarm equipment that will warn of the presence of H <sub>2</sub> S gas in concentrations that could be harmful.	X	X	X	X
Protective Breathing Equipment – will be maintained at two or more locations at the site.	X	X	X	X



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<b>Production Operations</b>				
If the actual H <sub>2</sub> S concentration in the gas stream exceeds listed levels, implement required controls.				
Provision	≥10 ppm and <100 ppm	≥100 ppm with 100 ppm ROE <50 ft	≥100 ppm with 100 ppm ROE >50 ft and <3000 ft and contains no public area or public road	≥100 ppm with 100 ppm ROE >50 ft and contains public area, ≥100 ppm with 100 ppm ROE >3000 ft, ≥500 ppm with 500 ppm >50 feet and ROE contains public road
Flare Stacks – provide a suitable method for lighting the flare. Use an automatic ignition source or ignition system to light the stack.			X	X
Materials – must meet requirements of NACE MR0175			X	X
Job Hazard Analysis (JHA) – conduct a JHA before beginning tasks that are non-routine (as defined in the <a href="#">Pre-Job Planning Protocol</a> ) or activities that are without a procedure. The JHA must include respiratory precautions and a stand-by person.		X	X	X
Evacuation Plan – establish an evacuation plan during the pre-task tailgate when working at H <sub>2</sub> S facilities that includes communicating wind direction (e.g., wind indicators on location) and identifying muster areas and emergency exits.	X	X	X	X
Wind Indicators – will be installed at strategic locations at or near the site, be readily visible from any location on site, placed where wind movement is unobstructed and be elevated and rotate freely.	X	X	X	X
Signs –refer to <a href="#">Appendix G</a> .	X	X	X	X



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Security – unattended fixed surface facilities will be protected by fencing and secured when within ¼ mile of public area – at least two exits for escape capable of opening from inside must be provided.			X	X
Enclosed buildings – provide suitable exits for escape capable of opening from the inside and located so that emergency escape can be easily accomplished (consider multiple exits based on size and configuration).		X	X	X
Contingency Plan – an organized plan of action for alerting and protecting the public following an accidental release of a potentially hazardous volume of H <sub>2</sub> S.				X
Training – Refer to <a href="#">Appendix I</a> .	X	X	X	X
Monitoring Equipment – fixed detection and alarm equipment that will warn of the presence of H <sub>2</sub> S gas in concentrations that could be harmful.				X
Protective Breathing Equipment – make personal respirators available so that the equipment is quickly and easily accessible to essential personnel.	X	X	X	X

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## APPENDIX E: CHEMICAL REACTIVITY HAZARDS

### H<sub>2</sub>S Reactivity with Other Chemicals

H<sub>2</sub>S gas may produce dangerous chemical reactions in the presence of incompatible substances. When mixing chemicals where H<sub>2</sub>S gas may be present:

- Consult SDS's
- Take appropriate precautions

Oilfield acids commonly used in downhole clean-up and stimulation treatments can react with iron sulfide pipe scale to generate high concentration of H<sub>2</sub>S gas at the surface during well work.

H<sub>2</sub>S gas readily dissolves in both water and liquid hydrocarbons. Sudden changes to these mixtures may cause the release of high concentration of H<sub>2</sub>S gas. These changes include, but are not limited to:

- Pressure or temperature increases or decreases
- Severe agitation or mixing
- The addition of other chemicals to a mixture

### Iron Sulfide

Iron reacts with H<sub>2</sub>S to form a substance called iron sulfide. This material is typically a dark brown to black powder material or a sludge:

- Found inside piping, vessels, iron sponge and/or other equipment where H<sub>2</sub>S is, or has been present
- Will ignite and burn in the presence of oxygen in air (pyrophoric)

Special precautions must be taken where iron sulfide is present to minimize the risk of a fire or subsequent ignition of a gas source.

Waste materials containing iron sulfide must also be handled and disposed of by:

- Keeping thoroughly wetted with water during handling and storage
- Placing in a safe location away from gas piping and/or process areas
- Monitoring carefully to prevent ignition and re-wetting as needed
- Determining if transportation and disposal requires permits

Consult the EHS Department for additional guidance on handling and disposal issues.

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## APPENDIX F: DRILLING, COMPLETION AND WORKOVER ACCESS TO LOCATION

Refer to API RP 49, 'Recommended Practice for Drilling and Well Service Operations Involving Hydrogen Sulfide,' for more information.



Appropriate CAUTION and DANGER signs will be posted according to state requirements or [Appendix G](#).

**NO HAZARD CONDITION:** Any well that does not or will not penetrate a known H<sub>2</sub>S formation. H<sub>2</sub>S equipment is not required.

**CONDITION I: Potential Danger to Life and Health:** Well Operations Under Control.

- Warning Device: Green (H<sub>2</sub>S concentration < 10 ppm).
- Characterized By: Routine well operations in zones containing H<sub>2</sub>S. H<sub>2</sub>S may be present at concentrations below 10 ppm.
- General Action:
  - a. Check safety equipment for proper functioning and keep it available.
  - b. Be alert for a condition change.
  - c. Follow instructions of on-site PIC.

**CONDITION II: Moderate Danger to Life and Health:** Critical Well Control Operations.

- Warning Device: Yellow (H<sub>2</sub>S concentration > 10 ppm and < 30 ppm).
- Characterized By: H<sub>2</sub>S is or potentially may be present up to 30 ppm on the well location.
- General Action:
  - a. Stay in the SAFE BRIEFING AREA if not working to correct the situation.
  - b. Follow instructions of the on-site PIC.
  - c. The on-site PIC will follow H<sub>2</sub>S Contingency plan procedures.

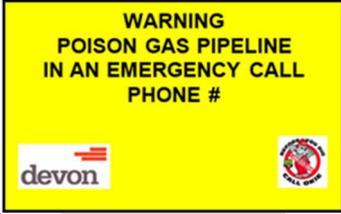
**CONDITION III: Extreme Danger to Life and Health:** Loss of Well Control

- Warning Device: Red (H<sub>2</sub>S concentration > 30 ppm).
- Characterized By: H<sub>2</sub>S concentration is above, or potentially may be above 30 ppm.
- General Action:
  - a. Stay in the SAFE BRIEFING AREA if not working to correct the situation.
  - b. Follow instructions of the on-site PIC.
  - c. The on-site PIC will make appropriate notifications, activate the audible alarm and initiate the H<sub>2</sub>S Contingency plan.
  - d. If the well is ignited, the burning H<sub>2</sub>S will be converted to sulfur dioxide, which is also dangerous to life and health. Therefore, DO NOT assume that the area is safe after the gas is ignited. Continue to observe applicable emergency and safety procedures and follow the instructions of the on-site PIC.

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## APPENDIX G: H<sub>2</sub>S SIGNAGE

Examples of H<sub>2</sub>S signs are provided below and can be used when a state does not have specific sign requirements.

<p>Post signage along the right-of-way of H<sub>2</sub>S pipelines and at public road crossings where H<sub>2</sub>S concentration is 100 ppm or greater.</p>	
<p>Post 'CAUTION' signs at entrance points and/or roads which provide direct access to sites where H<sub>2</sub>S concentration exceeds 10 ppm before treatment.</p> <p>Note: In the state of Texas, a 'Caution' sign is required by the Texas Railroad Commission where H<sub>2</sub>S concentration exceeds 100 ppm.</p>	
<p>Post basic notice signs in Texas at sites and entrance points and/or roads which provide direct access where H<sub>2</sub>S concentration exceeds 10 ppm before treatment.</p>	
<p>Post 'DANGER' signs at sites and entrance points and/or roads which provide direct access where H<sub>2</sub>S concentration exceeds 100 ppm.</p>	
<p>Post additional 'Danger' signs for the following conditions:</p> <ul style="list-style-type: none"> <li>• Outside all access doorways leading into enclosed buildings where the H<sub>2</sub>S concentration is 100 ppm or greater in the gas or liquid stream</li> <li>• At tank battery stairways and/or ladders where the measured H<sub>2</sub>S concentration is greater than 100 ppm in the vapor space of tanks or production equipment</li> <li>• When opening equipment where produced fluids or gases with H<sub>2</sub>S concentration 100 ppm or greater are being processed or handled</li> <li>• When H<sub>2</sub>S concentration in the working atmosphere exceeds 10 ppm</li> </ul>	



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## APPENDIX H: H<sub>2</sub>S SAMPLING FREQUENCY

H <sub>2</sub> S Levels	Test Frequency
<b>Gas Stream</b>	
H <sub>2</sub> S concentration between 10 ppm and 100 ppm.	Annually
H <sub>2</sub> S concentration greater than 100 ppm and changes will impact ROE where contingency plans are required.	Annually
H <sub>2</sub> S concentration greater than 100 ppm however any changes will not impact the contents of contingency plans.	As necessary
<b>Bacterial</b>	
H <sub>2</sub> S concentration greater than or equal to 10 ppm. <b>Note:</b> When H <sub>2</sub> S concentration drops below 10 ppm, sampling may end.	As necessary

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## APPENDIX I: H<sub>2</sub>S TRAINING REQUIREMENTS

H<sub>2</sub>S training will include the following material:

1. H<sub>2</sub>S Awareness training will include the following topics:
  - a. Hazards, characteristics and properties of H<sub>2</sub>S and SO<sub>2</sub>
  - b. Sources of H<sub>2</sub>S and SO<sub>2</sub>
  - c. H<sub>2</sub>S exposure controls
  - d. H<sub>2</sub>S exposure response
  
2. H<sub>2</sub>S Operations training will include the following topics, listed in ANSI Z390.1:
  - a. Hazards, characteristics and properties of H<sub>2</sub>S and SO<sub>2</sub>
  - b. Sources of H<sub>2</sub>S and SO<sub>2</sub>
  - c. Safety precautions, detection methods
  - d. Symptoms of H<sub>2</sub>S exposure
  - e. Rescue techniques and first aid/CPR
    - i. Employees expected to work in a stand-by capacity will be trained in first aid/CPR and limitations/rescue expectations (e.g., pulling worker upwind or adjusting their SCBA). First aid/CPR may be completed as a standalone class.
  - f. Proper selection, use and limitations of breathing equipment – Safety and Support
    - i. Employees not expected to work in an environment where the H<sub>2</sub>S concentration is 10 ppm or greater in the working atmosphere are not required to be placed in a respiratory protection program (e.g., clean-shaven, fit tested, etc.) but should be aware of the appropriate respiratory protection for use in H<sub>2</sub>S environments.
  - g. Wind direction awareness and routes of egress
  - h. Emergency response procedures
  
3. H<sub>2</sub>S Rescue training will include the following topics:
  - a. Requirements to be a stand-by person in H<sub>2</sub>S environments
  - b. Rescue procedures
  - c. Proper use of required PPE and ability to retrieve a downed individual from a hazardous atmosphere from the same work level or fixed stairway accessed platform by simple extrication of the victim from the hazardous atmosphere

**Note:** Rescue where a victim would require packaging for extrication or special rescue equipment would require external training and certification (e.g., high angle rescue training for ladder accessed platforms).



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### ATTACHMENT A: APPROVAL, REVIEW AND MODIFICATION HISTORY

[Approval, Review and Modification History](#)