



Hydrogen Sulfide (H₂S) Standard

1. PURPOSE

This Standard provides minimum requirements to safeguard employees, contractors and the public from potential exposure to Hydrogen Sulfide (H₂S) gas. Employees and contractors must also follow mandatory local, state, and federal statutory rules and regulations.

2. SCOPE

This Standard is applicable to employees employed by Expand Energy (EXE), its affiliates or subsidiaries who are working on EXE properties or on the company's behalf.

Contractors **shall** have their own Standard that meets or exceeds regulatory requirements.

3. DEFINITIONS

Approved Respiratory Protection (ARP) – Approved respirators *for IDLH atmospheres* include a full facepiece pressure demand self-contained breathing apparatus (SCBA) or a combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply (i.e., egress bottle) of at least 5-minute capacity.

Breathing Zone – Area in front of the user's body near nose and mouth.

Contingency Plan – Written document that provides an organized plan of action for alerting and protecting personnel and the public within an area of exposure, following an intentional or accidental release of a potentially hazardous volume of H₂S.

Hydrogen Sulfide (H₂S) – A toxic, colorless, poisonous, and flammable gas that is soluble in liquids; H₂S can be associated with petroleum operations and is irritating to the eyes, nose, lungs and can cause immediate death at relatively low concentrations.

H₂S Location – A well facility or worksite where the H₂S concentration ≥100 parts per million (ppm) in the gaseous mixture (gas stream or well stream) or has the potential for an airborne concentration of ≥10 ppm.

Immediately Dangerous to Life and Health (IDLH) – An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere; *the IDLH concentration for H₂S is ≥100 ppm.*

Occupational Exposure Limit (OEL) – The maximum allowable concentration to a chemical or physical agent over a specified period to which it is believed that nearly all workers may be repeatedly exposed without adverse effect.

- 10 ppm is the time weighted average for H₂S in an 8-hour day.
- Exposures must not exceed 20 ppm (ceiling) at any time, with the following exception: if no other measurable exposure occurs during the 8-hour work shift, exposures may exceed 20 ppm, but not more than 50 ppm (peak), for a single time period up to 10 minutes.

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 H₂S concentration in the air will dilute to a specific concentration.

Shall – Denotes a minimum requirement to conform to the Standard. To aid the reader, “**shall**” requirements are identified in bold. Any deviation from a minimum requirement must be approved via the Standard Exception Form.

Should – Denotes a recommendation, or that which is advised, but not required to conform to the Standard.

Stand-by Person – Individual located outside the IDLH atmosphere to maintain continuous visual, voice, or signal line communication with the employee(s) in the IDLH atmosphere; the individual is trained and equipped (i.e., Full Face Positive Pressure SCBA, direct-reading instrument) to provide effective emergency assistance.

Sulfur Dioxide (SO₂) - A toxic gas created when Hydrogen Sulfide is burned; it is heavier than air and forms sulfuric acid when combined with moisture (including perspiration).

Well Stream – The fluids and gas produced from a well; the well stream can include natural gas, natural gas liquids, crude oil and produced water.

4. ROLES & RESPONSIBILITY

SUPERVISORS

- Understand and comply with the provisions of all regulatory and company requirements
- Ensure that periodic H₂S surveys and testing is performed as required
- Ensure that employees complete H₂S training as required
- Work with the HSE department to develop Contingency Plans as required by this Standard.
- Ensure that H₂S monitoring equipment is available to protect employees

ENGINEERING

- Perform ROE calculations as required in this Standard and determine if ROE impacts any public areas or public roads and if written contingency plans are required
- Ensure a risk assessment is performed and documented for fixed monitors locations

EMPLOYEES

- Understand and comply with this Standard
- Complete H₂S training
- Wear personal gas monitors and follow instructions on proper usage
- Follow emergency response procedures upon identification of a gas release or when fixed or personal H₂S monitor alarms

HSER DEPARTMENT

- Update and revise the H₂S Program as required
- Provide the required assistance to personnel to implement the program
- Assist in developing site contingency plan upon discovery of H₂S

5. REQUIREMENTS

5.1 H₂S SURVEYING AND TESTING

Surveys and tests are performed to identify facilities and tasks where potential exposure to H₂S may be anticipated.

5.1.1 WHEN TO TEST FOR H₂S

Surveys and testing for H₂S **shall** be performed periodically at Company work sites where there is reasonable expectation of H₂S being present in the gas stream and/or process fluids. Surveys and testing for H₂S **shall** be done as follows:

- In the gas stream during initial flowback of the well
- In the gas stream of a new facility prior to H₂S treatment
- When operational changes at existing facilities cause an anticipated change in H₂S concentrations

5.1.2 H₂S LOCATIONS

When survey and test results indicate the H₂S concentration ≥ 100 ppm in the gaseous mixture (gas stream or well stream) or has the potential for an airborne concentration of ≥ 10 ppm, the facility/worksite **shall** be designated as an H₂S Location.

5.1.3 REPORTING ON TEST RESULTS

- Document results using the H₂S Survey Form in Appendix A or similar
- Report H₂S concentration results to the Supervisor or relevant personnel
- Update in Company's internal well data management system

5.2 RADIUS OF EXPOSURE (ROE)

Engineering **shall** calculate the potential ROE for H₂S Locations; methodologies for doing so are outlined in Appendix C.

Engineering **shall** review ROE calculations when there is an indication of definitive changes in H₂S concentrations or facility volumes.

5.3 ENGINEERING AND EXPOSURE CONTROLS

Engineering control measures are required when exposure is determined to be above the Occupational Exposure Limit (OEL) and ROE triggers are exceeded.

Engineering controls include, but are not limited to:

- Enclosed process
- Remote automatic gauge lines
- Hydrostatic fluid measurement devices
- Flare lines
- Chemical treatment

5.4 CONTINGENCY PLANS

5.4.1 WHEN CONTINGENCY PLANS ARE NEEDED

A written Contingency Plan is required to be developed for H₂S Locations when results of ROE calculations indicate:

- Calculated 100 ppm ROE is greater than 50 feet and includes any part of a Public Area other than a Public Road
- Calculated 100 ppm ROE is equal to or greater than 3,000 feet and includes any part of a Public Road
- Calculated 500 ppm ROE is greater than 50 feet and includes any part of a Public Road

*See Appendix B for a flowchart that illustrates this determination process.

Additionally, Contingency Plans are required for:

- Drilling operations with a known H₂S zone and/or prior to spud on an existing H₂S Location, and
- Completion operations including drillout, tube up, flowback and frac operations; Contingency Plans **shall** be in place prior to opening the well bore.

5.4.2 CONTINGENCY PLAN CONTENTS

The Plan can be a stand-alone document or included in the local EAP and **shall** include, at a minimum:

- How to alert public safety personnel of an emergency
- How to request assistance to remove the public from an area of exposure
- Site security provisions including emergency communications and muster point locations
- Plan for advance briefing of the public within the area of exposure
- A call list of the following:

Emergency Services	Enforcement Services	Other Services
Ambulance service	City police	Dept of public safety
Fire department	County sheriff	Contractors
Hospital	Local supervisors	Equipment services
		Public agencies

Contingency plans **shall** be maintained on site or at the local field office. Contingency plans **shall** be reviewed periodically. The Plans **shall** be revised when the calculated ROE for an H₂S Location changes.

5.4.3 EMERGENCY RESPONSE / DRILLS

Contingency Plans **shall** be periodically exercised by conducting drills; frequency may be based upon risk assessments and potential public exposure, or alternate criteria, but **shall** occur at least once annually within the Business Unit.

Drills may involve tabletop exercises, classroom discussions/scenarios, or actual mobilization of personnel, equipment, etc., or any combination of these activities. Drills **shall** be documented, and records retained at the local field office.

When additional H₂S safety equipment is needed, an Emergency Response Trailer may be deployed by a specialized contractor trained in H₂S emergency response. The Emergency Response Trailer may include breathing air cascade and manifold system, Self-Contained Breathing Apparatus (SCBAs) and air supplied airline respirators with emergency escape bottles, colorimetric sampling tubes, hand-held multi-gas monitors, personal H₂S monitors and be staffed by trained personnel.

5.5 WIND SOCKS, SIGNAGE, FENCING

5.5.1 WIND DIRECTION INDICATORS

Wind socks or other suitable type of wind direction indicators **shall** be:

- Installed at facilities/worksites where H₂S concentration is ≥10 ppm in the gas stream
- Visible from any point on site and located in illuminated areas when possible
- Sufficient in number

5.5.2 SIGNS

- CAUTION signs must be posted at facilities/worksite entrances where H₂S concentration is ≥10 ppm in the gas stream
- DANGER signs **shall** be posted at facility/worksite entrances where H₂S concentration is ≥100 ppm in the gas stream
- DANGER signs **shall** be posted at a tank battery stairway and/or at ladders where H₂S concentration is ≥100 ppm in the gas stream

* See Appendix D – Hydrogen Sulfide Warning Signs

5.5.3 PIPELINES

Pipelines containing any concentration of H₂S must be marked by posting markers (signs) at:

- Public road crossings where there are buried EXE pipelines containing H₂S
- Within a public area and along a public road at intervals sufficient so that adjacent markers are visible
- Posted markers (signs) **shall** include:
 - A statement acknowledging EXE ownership of the line
 - Poison Gas (or equivalent) and notification that potential danger exists
 - Emergency telephone number

* Markers that comply with Department of Transportation (DOT) regulations satisfy this requirement.

5.5.4 FENCING

Security fencing **shall** be installed around facilities with ≥100 ppm H₂S in the gas stream and **shall** include:

- Chain link fence or barbed wire fence

- Gates capable of being closed and locked
- Chains or gates must be used on stairs and ladders leading to the top of storage tanks if separate fencing around the tank is not in place

5.6 H₂S DETECTION AND MONITORING SYSTEMS

5.6.1 PERSONAL AND PORTABLE MONITORS

- All personnel working at H₂S Locations **shall** wear a 4-gas monitor. Personal monitors **shall** be set to alarm at 10 ppm for H₂S.
- Use of personal gas monitors is not required for visitors when they are escorted by personnel with gas monitors.
- Personal gas monitors **shall** be worn outside of clothing and in the person's breathing zone.
- Personal gas monitors **shall** be maintained, calibrated and function tested in accordance with manufacturer's instructions.
- NOTE: Fixed Detection can be utilized for work directly over the wellbore provided conditions noted in EXE's PPE Standard are met.
- WARNING: Atmospheric testing for confined space permitting **shall** be performed by a trained Atmospheric Tester using an active pump-type monitoring device.

5.6.2 FIXED H₂S MONITORING SYSTEMS AT H₂S LOCATIONS

H₂S Locations with ≥100 ppm in the gas stream **shall** be equipped with fixed H₂S detection and alarm systems.

- At a minimum, fixed monitor detection **shall** be installed:
 - Near the wellhead(s)
 - At the base of tank battery
 - Near production equipment
- Any deviation from these locations requires a risk assessment conducted by the facilities engineering group, measurement, and HSER. The risk assessment **shall** be documented and retained.
- Review and follow applicable state regulations for using fixed H₂S monitor installation and use.
- Audible and visual alarm signals **shall** be located so they can be seen and heard throughout the facility and **shall** be activated at 10 ppm for low level alarm and at 20 ppm for high-level alarm.

- Fixed monitors and alarm systems **shall** be inspected, tested and maintained in accordance with manufacturers' recommendations.

5.7 ALARM RESPONSE

If fixed or personal alarms indicate an unanticipated atmospheric concentration of ≥ 10 ppm, personnel should evacuate the area, report to designated muster locations and follow emergency procedures.

Personnel responding to the alarms must be properly trained in evaluating alarm conditions.

Response to H₂S alarm conditions ≥ 10 ppm requires use of Approved Respiratory Protection (ARP).

Response to H₂S alarm conditions ≥ 100 ppm requires the same ARP, and standby personnel.

5.7.1 STANDBY PERSONNEL

Tasks that require opening closed systems at production facilities with gas stream concentrations ≥ 100 ppm H₂S require ARP and standby personnel, unless specific SOPs are approved and in place with sufficient controls and monitoring.

Additionally, Standby Personnel **shall**:

- be located on site but outside the IDLH (H₂S ≥ 100 ppm) atmosphere
- maintain visual/audible communication with personnel in the IDLH atmosphere
- know who to notify for additional assistance
- be trained in First Aid and CPR
- know how to use appropriate rescue and communication devices
- know how to provide emergency assistance applicable to their specific work environment
- be equipped with:
 - Full Face Positive Pressure SCBA (fully charged)
 - Portable handheld monitor with H₂S sensor
 - Appropriate personal retrieval equipment if entering a confined space or enclosure.

NOTE: Work environments involving confined spaces have specific rescue requirements in addition to H₂S requirements. See Confined Space Entry Standard.

5.8 RESPIRATORY PROTECTION

5.8.1 REQUIREMENTS FOR WHEN TO USE RESPIRATORY EQUIPMENT

Respiratory protection equipment **shall** be utilized when:

- Work area airborne H₂S concentration > 10 ppm
- Performing tasks that could result in potential exposure to H₂S at unknown concentration
- Performing any job identified exceeding OELs
- Response to alarm conditions ≥10 ppm

Only **Approved Respiratory Protection (ARP)** is appropriate for working in atmospheres containing H₂S. ARP includes:

- a full facepiece pressure demand self-contained breathing apparatus (SCBA), or
- a combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply (i.e., egress bottle) of at least 5-minute capacity.

Warning: Never use an air-purifying or cartridge type respirator when working around H₂S, as these will not protect you from breathing H₂S.

5.8.2 EMERGENCY EGRESS RESPIRATORS

Some H₂S Locations may be provided with emergency egress respirators (i.e., 5-minute escape packs). These egress respirators are not to be used for working in an atmosphere containing H₂S; they are to be used for emergency egress only.

5.8.3 QUALIFICATIONS FOR USING RESPIRATORS

Personnel utilizing respiratory protection **shall** meet the requirements of the Respiratory Protection Standard, have additional training, and complete a medical evaluation and fit test. Facial hair **shall not** come between the sealing surface of the facepiece or interfere with the valve function of the respirator. Refer to the EXE Respiratory Protection Program.

5.9 VISITORS TO H₂S LOCATIONS

Visitors to H₂S Locations **shall** be escorted by an individual who has been trained on H₂S hazards and Company procedures, and Visitors **shall** be briefed on the following:

- Site-specific sources of H₂S
- Health hazards of H₂S
- Routes of egress / Emergency assembly areas
- Applicable alarm sounds

- How to respond in the event of an emergency

6. TRAINING

All employees who have potential work on a H₂S Location **shall** be trained in the hazards and characteristics of H₂S, personal protective equipment and emergency procedures when working in or around H₂S, before entering the location.

All employees who have completed initial H₂S awareness level training **shall** complete refresher training at least annually thereafter.

Additional training may be required based on job responsibilities, such as working in IDLH environments or emergency response services.

Training records, along with medical evaluation and fit test records will be maintained and readily available.

7. AUDIT REQUIREMENTS

Audits **shall** be periodically conducted by HSER in order to confirm compliance with this Standard.

8. STANDARD EXCEPTIONS

Requirements outlined in this Standard **shall** be followed, unless a Standard Exception is filed on behalf of, and with the approval of the Operations Manager.

9. REFERENCES

- HSER-EXE-STD-028 Respiratory Protection Standard
- HSER-EXE-STD-029 Confined Space Entry Standard
- HSER-EXE-STD -025 Personal Protective Equipment Standard
- 29 CFR 1910.134 Respiratory Protection
- API RP 49 Recommended Practice for Drilling and Well Servicing Operations Involving Hydrogen Sulfide
- API RP 55, Recommended Practice 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
- Texas Railroad Commission Title 16 Section 1 Rule 3.36
- Pennsylvania Bureau of Oil and Gas Management Rule 78.77 Subchapter D

- Louisiana Administrative Code: Title III Chapter 3 Section 309 – Regulations Pertaining to the Release of Natural Gas from Pipelines and Associated Equipment

10. DOCUMENT CONTROL TABLE

Title: HYDROGEN SULFIDE (H ₂ S) STANDARD		Document Number: HSER-SAF-EXE-STD-011		
Next Review Date: 04/16/2028				
Originating Department: HSER				
Version History				
Version	Issue Date	Description	Author(s)	Approved By
1.0	03/24/2025	Developed EXE H ₂ S Standard	Katie Rhoads	OGB
1.1	4/16/2025	Removed vapor space testing requirement	Katie Rhoads	OGC

11. APPENDICES

- Appendix A – H₂S Survey/Testing Results Form
- Appendix B – Contingency Plan Flowchart
- Appendix C – Radius of Exposure Determination
- Appendix D – Hydrogen Sulfide Warning Signs

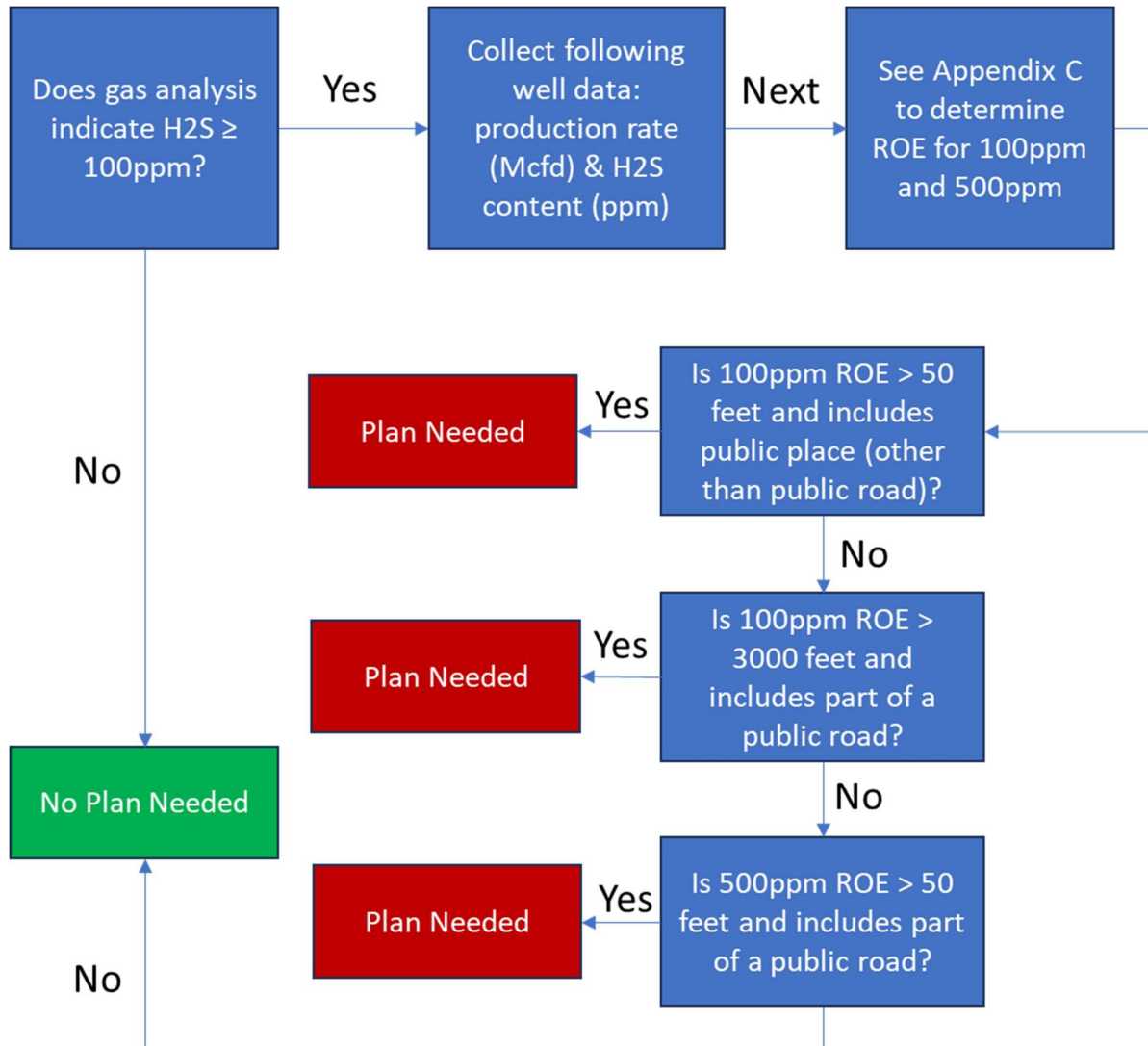
APPENDIX A – SAMPLE RESULTS FORM

GAS STREAM TESTING RESULTS					
Manufacturer:		Serial #		Instrument:	
Location	H ₂ S	Location	H ₂ S	Location	H ₂ S
Name of Tester:				Date/Time:	

This form is recommended for use when documenting the results of H₂S Surveys and Testing, as described in the Requirements section of this Standard. Refer to Section 5.1 for details.

APPENDIX B – CONTINGENCY PLAN FLOWCHART

Use the flow chart below to determine the need for an H₂S Contingency Plan. (If the state has more stringent requirements, those should be followed.)



APPENDIX C – RADIUS OF EXPOSURE DETERMINATION

Below are methodologies that may be used to determine ROE for H₂S Locations.

1. Link to ROE Calculator:

[HSER-SAF-CHK-FRM-063 - Radius of Exposure Calculations Form.pdf](#)

2. ROE EQUATIONS (for 100ppm and 500ppm ROE's)

$$X = (1.589 \times H_2S \times Q)^{0.6258}$$

Where: $X = 100$ ppm Radius of Exposure (ROE), (feet)

H₂S = Concentration of Hydrogen Sulfide found in the gaseous phase of the produced fluid, (ppm)

Q = Maximum Volume of Gas determined to be available for escape in MMCFD (million cubic feet per day) at 14.65 psia and 60°F

$$X = (0.4546 \times H_2S \times Q)^{0.6258}$$

Where: $X = 500$ ppm Radius of Exposure (ROE), (feet)

H₂S = Concentration of Hydrogen Sulfide found in the gaseous phase of the produced fluid, (ppm)

Q = Maximum Volume of Gas determined to be available for escape in MMCFD (million cubic feet per day) at 14.65 psia and 60°F

APPENDIX D – HYDROGEN SULFIDE WARNING SIGNS

Examples of hydrogen sulfide warning signs are provided in this appendix; these can be used when a state does not have specific sign requirements.

Display 'CAUTION' signs at sites where concentrations of H₂S ≥10 ppm



Display 'DANGER' signs at sites where concentrations of H₂S ≥100 ppm in the gas stream.



Post signage at tank battery stairways and/or ladders where measured H₂S concentrations are ≥100 ppm in the gas stream.

