



HYDROGEN SULFIDE H₂S

Integrated Water Services, Inc.
(the Company)



Purpose

The purpose of this program is to establish minimum requirements for site specific H₂S safety, which will enhance safety in the occupational setting where hydrogen sulfide is present or is recognized as being potentially present.

Scope

This program applies to all employees and temporary employees of Integrated Water Services.

When work is performed by a subcontractor on a company site, the contractor's written safety program shall take precedence for their employees. However, subcontractors may adopt this procedure for their use.

Definitions

- **Contingency Plan:** a site-specific written document that provides an organized plan for alerting and protecting the public within an area of exposure following the accidental release of all potentially hazardous atmospheric concentrations of hydrogen sulfide.
- **Exposure Level:** permissible exposure level of hydrogen sulfide is 10 PPM for an 8-hour, time weighted average.
- **Gas Detector Instrument:** An instrument/detector to measure levels of H₂S. Instruments may be electronically or manually operated.
- **Hydrogen Sulfide (H₂S):** is an extremely deadly, toxic gas that in its pure state is colorless and is heavier than air. Additionally:
 - It is the second most toxic gas known to man, ranking behind hydrogen cyanide and ahead of carbon monoxide.
 - It has the odor of rotten eggs at low concentrations.
 - In higher concentrations rapidly paralyze the olfactory nerves (sense of smell).
 - Is soluble in water and is flammable and poses a definite threat of explosion.
- **Parts Per Million (PPM):** parts of vapor or gas per million parts of contaminated air by volume.
- **Personal H₂S Monitor:** An electronic instrument worn on the person that is set to alarm at 10 PPM of H₂S.
- **Possible Locations of Where May Be Exposed to H₂S During Their Job Functions:** While clients are required to notify Integrated Water Services of known H₂S locations the majority of time H₂S can be located in drilling operations, recycled drilling mud, blowouts, water from sour crude wells, blowouts, tank gauging (tanks at producing, pipeline and refining operations), during routine field maintenance involving hydrocarbons, tank batteries and wells.
- **Venting:** the process of discharging a material to the atmosphere through a series piping and/or venting devices, to facilitate the proper and safe dispersion of toxic materials and to minimize personnel exposure.



Key Responsibilities

Managers and Supervisors

- Shall ensure all employees who are to be assigned to work at locations where hydrogen sulfide is known to be present or suspected to be present in any concentration have been trained in hydrogen sulfide safety.
- Shall ensure employees have been medically approved to wear respirators and trained on the safe use of respirators and receive a respirator fit test in accordance with Integrated Water Services Respiratory Protection Program.
- Shall ensure employees have been trained and familiar with personal H₂S monitors and gas detection instruments.

Employees

- Employees are responsible for complying with this program.

Procedure

Characteristics of Hydrogen Sulfide

The characteristics of hydrogen sulfide include: toxic gas, colorless, odor or rotten eggs at very low concentrations, is soluble in water and is flammable:

- Toxicity – See table below. Hydrogen sulfide is a very dangerous and deadly gas - it is colorless and heavier than air. It can accumulate in low places and in small concentrations. Exposure to certain concentrations of H₂S can cause serious injury or death.
- Color - H₂S is colorless – you can't see it.
- Odor – it has a strong, pungent, somewhat distasteful odor similar to rotten eggs. In higher concentrations, it can deaden the sense of smell (olfactory nerve). Do Not Rely On Smell To Detect H₂s – Rely Strictly On Instruments Designed To Measure Concentrations Of H₂S.
- Solubility – H₂S mixes with water.
- Flammability – H₂S is an explosive gas.
- Toxic By Products – H₂S presence can create sulfur dioxide which can ignite without warning

Toxic Effects of Hydrogen Sulfide

CONCENTRATION	PHYSICAL EFFECT
.01 PPM	Can smell odor.
10 PPM	Obvious and unpleasant odor. Beginning eye irritation. ANSI permissible exposure level for 8 hours (enforced by OSHA).
100 PPM	Immediately Dangerous to life or Health (IDLH) Kills smell in 3-15 minutes; may sting eyes and throat. May cause coughing and drowsiness. Possible delayed death within 48 hours.
200 PPM	Kills smell shortly, stings eyes and throat. Respiratory irritation. Death after 1-2 hours exposure.
500 PPM	Dizziness; breathing ceases in a few minutes. Need prompt rescue



	breathing (CPR). Self-rescue impossible because of loss of muscle control.
700 PPM	Unconscious quickly; death will result if not rescued promptly. 1000 PPM Unconscious at once, followed by death within minutes.

Health Effect of Exposure to Hydrogen Sulfide

Some basic health effects of H₂S can include eye irritations, effects nerve centers of the brain which control breathing, will paralyze the olfactory nerves, will cause death at relatively low concentrations.

General Requirements

Integrated Water Services has a written confined space program per 29 CFR 1910.146 and employees must be aware of site-specific contingency/emergency plans.

Each person entering a H₂S designated location, regardless of the concentration, shall wear a personal H₂S monitor that is set to alarm at 10 PPM and shall carry a 5-minute escape pack with them at all times. When the alarms sound the employees must either evacuate the area or don the escape pack and then evacuate the area.

When work requires opening any equipment on location that has the potential of releasing concentrations of H₂S at 100 PPM or higher, two or more H₂S trained persons shall be present and follow these procedures prior to and during the opening of the equipment:

- Each person entering the H₂S location shall don a personal H₂S monitor prior to entry.
- A tailgate meeting will be held with everyone on location to discuss the work plan, the responsibilities of each person and the site-specific emergency action plan.
- Each person shall have either a self-contained breathing apparatus (SCBA) or a supplied airline respirator equipped with a 5-minute escape pack and shall be worn when opening the equipment to the surrounding atmosphere.
- At least one person (per two workers), equipped with a SCBA will act as a stand-by person and may not participate in the work being performed until the atmosphere has been tested and found to have no H₂S present in quantities over 10 PPM. The stand-by person shall be stationed up wind, within 100 feet and in clear view of the workers.
- If an operator or other third party provides the stand-by person, it will be the responsibility of the Integrated Water Services supervisor in charge to verify that the person has been H₂S, CPR, and First Aid trained, and that they have been provided the proper respiratory equipment.
 - Only Integrated Water Services employees may wear Integrated Water Services respiratory protection equipment.
 - If Integrated Water Services employees use client or other third party equipment, the equipment must be inspected to ensure it is safe for use and meets Integrated Water Services requirements.
- After the equipment has been locked and tagged out (per Integrated Water Services Lockout/Tagout Program), opened, and the H₂S concentration has been cleared to less than 10 PPM, the stand-by person will no longer be required. Work may then be performed without respiratory equipment, except for the required 5-minute escape pack.

Safe Work Procedures

- Maintain compliance with permit requirements of Integrated Water Services and any requirements by of the client.



- Verify that proper safety equipment is available, functioning properly, and is utilized.
- Check and remain aware of wind conditions and direction.
- Perform a thorough check of the downwind area prior to the start of any potentially hazardous work activity.
- Check for other personnel.
- Check for unidentified ignition sources.
- Ventilate work areas by venting and purging lines and vessels prior to beginning any work activities.
- Keep all non-essential personnel away from work areas.
- Immediately vacate the area when any H₂S monitor sounds and do not re-enter without proper respiratory protection.

Required Equipment

The following equipment shall be provided and used as required by this program:

- Methods of detecting H₂S by the use of fixed or portable monitors that will alarm at the appropriate permissible exposure limits of 10 PPM.
- Portable H₂S gas testing instrument, either electronic or manual pump operated, capable of testing the suspected concentrations of H₂S in the system.
- Each testing instrument must be capable of testing the suspected concentrations of H₂S by using the manufacturer's recommended calibrated tube or other means of measuring the concentration of gas.
- Testing instruments shall be calibrated periodically according to the manufacturer's recommendation, and at least annually.
- Calibration kits with a regulator for calibrating the personal monitor.
- Calibration gas cylinder for testing the personal monitor.
- Approved self-contained breathing apparatus or airline respirator with escape SCBA should be used with H₂S with a 5-minute escape pack, and shall be worn when opening the equipment to the surrounding atmosphere.
- At least one person (per two workers), equipped with a SCBA will act as a stand-by person and may not participate in the work being performed until the atmosphere has been tested and found to have no H₂S present in quantities over 10 PPM. The stand-by person shall be stationed up wind, within 100 feet and in clear view of the workers.
- If an operator or other third party provides the stand-by person, it will be the responsibility of the Integrated Water Services manager/supervisor in charge to verify that the person has been H₂S, CPR, and First Aid trained, and that they have been provided the proper respiratory equipment.
- Respirator wearers requiring corrective eyewear will be fitted with spectacle kits according to the respirator manufacturer, at no expense to the employee.
- Respirators and their components including all fittings of hoses shall not be interchanged, which if done, would violate the approval rating of said respirator or related equipment.

Medical

Each employee shall have completed a medical evaluation by a physician or licensed health care professional to determine the employee's ability to wear a respirator as required by the Integrated Water Services Respiratory Protection Program.

Each employee will successfully complete the medical questionnaire and examination before being allowed to be fit tested with a respirator.



Training

Employees required to work on H₂S locations will be trained. Training shall consist of:

- Physical and chemical properties of H₂S
- Sources of H₂S
- Human physiology
- Signs and symptoms of H₂S exposure, acute and chronic toxicity
- Symptomatology of H₂S exposure
- Medical evaluation
- Work procedures
- Personal protective equipment required working around H₂S
- Use of contingency plans and emergency response
- Burning, flaring, and venting of H₂S
- State and federal regulatory requirement
- H₂S release dispersion models
- Rescue techniques, first aid, and post exposure evaluation
- Use, care, and calibration of personal monitors and gas detection instruments
- Respirator inspections and record keeping

Each respirator wearer will complete Respiratory Protection training and a Respirator Fit Test, after being given a medical clearance and before entering any H₂S location.

Employees and other personnel visiting H₂S locations who will not be involved in the work shall be briefed in the following areas prior to entering:

- Site-specific sources of H₂S
- Health hazards of H₂S
- Routes of egress
- Emergency assembly areas
- Applicable alarm signals and
- How to respond in the event of an emergency.

Rescue

Each employee, when working alone in a H₂S designated area, shall plan and become familiar with self-escape procedures to include being aware of wind direction and obstacles to avoid when exiting the work area.

Employees working under the buddy system shall pre-plan an emergency rescue and/or evacuation procedure prior to commencing work and arrange for periodic communications with his/her supervisor.

Respirator Inspections

Respirators will be inspected by the employee before each use and at least monthly.

The inspection will include the respirator face piece, hose, harness, 5-minute escape pack cylinder and all other components of the air supply systems used.



Monthly inspections will be documented as per the Integrated Water Services Respiratory Protection Program, and will be kept on file at the local office for review during safety audits.

Monitors and Gas Detector Calibration

Each personal H₂S monitor shall be calibrated as per manufacturer requirements and the results recorded on the calibration log.

Those monitors that do not require calibrating shall be bump checked on a monthly basis with calibration gas to test alarms.