Wafra Joint Operations

JOSOP 500 - H2S Technical Standard

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Version 1.0

Contents

1.0 Scope, Purpose, Objectives

1.1 Scope

This Safe Work Practice (SWP) applies to all Wafra Joint Operations (WJO) personnel, secondees, contractors and visitors within the WJO Field area, which includes the operations areas, well sites, pipeline right of ways, valve stations, and any other production areas or equipment that have the potential to have hydrogen sulfide (H_2S).

Any deviation from the requirements identified in this Safe Work Practice must be approved by the responsible Manager or his/her designee, in writing.

1.2 Purpose

This SWP outlines the roles, responsibilities, and procedures for safely working in areas with potential exposure to H_2S. It provides the necessary information to fully understand the hazards of H_2S and the procedures to ensure the work is performed in a safe and controlled manner while working in these areas.

1.3 Objectives

This SWP establishes the minimum requirements for the safe performance of work in areas with potential exposure to H_2S.

2.0 Requirements

Work must be planned, managed, and completed in accordance with this Wafra Joint Operations (H_2S) Safe Work Practice.

1. Personal H_2S detectors, or badge type detectors, shall be worn at all times by all personnel while performing work in locations which may have H_2S.
2. Operations, Maintenance and Drilling and Completions personnel or Emergency Response Team Members who are required to wear SCBA to perform their duties must be clean-shaven in the seal area of the SCBA face mask.
3. Personnel and visitors shall obey all warning signs, alarms, and emergency instructions in the gas field area.

4. Windsocks shall be mounted at work locations where H_2S could be present so they are visible to personnel at all times.
5. Black and yellow "Caution - H_2S" warning signs shall be posted in all H_2S Hazard Areas. These signs shall be in both English and Arabic languages with a single universal sign.
6. Breathing air equipment (e.g., airline respirator or SCBA) must be used whenever:
   a. work must be performed in a H_2S environment with levels higher than 5 ppm*;*
   b. work is being performed on in-service equipment known to contain H_2S concentrations above 100 PPM; (See WJO H2S Maps)
   c. personnel are responding to any LOC or H_2S alarm if the H_2S concentration is unknown. (See WJO First Break Procedure)

   Entry into atmosphere above 100 PPM H2S is prohibited even with supplied air. Atmosphere must be ventilated to reduce concentrations below 100 PPM before entry.

7. Whenever work must be carried out in an area with the potential to contain H_2S, the following must occur prior to performing the work:
   - The Permit Approver must be notified of the entry, and provide authorization before the work begins; and
   - Personnel and visitors should identify the windsocks and wind direction, and identify a safe muster point, upwind of the location. In some locations this may be substituted by a designated shelter in place.
8. Employees and contractors must perform a visual inspection of personal monitors daily to ensure unit appears to be in good working condition. A monthly bump test must be completed for personal H2S monitors. Additionally, a bump test must be performed immediately after an alarm event or if the monitor is suspected of damage.

Summary of inspection and bump test requirements

Activity	Frequency
Visual Inspection	Daily or prior to each use
Bump Test	1. Monthly 2. Immediately after an alarm event, or 3. When damage is suspected

9. Full calibration is required for the following:
   - After a bump test failure
   - Device displays failure alarm(s)
   - Device is exposed to concentration of H_2S gas above 100 PPM

10. Visitors to areas potentially containing H_2S:
    - Shall be given a H_2S Orientation before entering any industrial areas within WJO. This orientation shall include the hazards of H2S, what to do in case of an H2S alarm, and safe muster points;
    - Must be escorted by trained individuals at all times;
    - Must have a personal H_2S gas detector (one per every 4 persons); and
11. The following training and documentation is required:
    - All personnel who work in the field on a regular basis must complete a H_2S Training Class led by a qualified instructor. This training must cover all aspects of this SWP as well as how to use and maintain personal gas detectors that are used in the WJO Field.
    - Refresher training must be completed:
        - annually, or
        - as needed when identified by: verification, inspections, incidents or audits; or
        - when changes to operating conditions require additional training.
    - SCBA specific training must be completed by all personnel who have duties that may require the use of an SCBA.
        - SCBA refresh training must be completed as per WJO TNA.
    - Individuals with job duties that require them to operate portable gas detectors must receive specific training on these correct operations and maintenance of detectors to be used.
    - Contractor companies are responsible for providing H_2S training to their employees and must provide documentation of training upon request.
    - Training records shall be kept for a minimum of two years.

3.0 General H2S Information

H_2S is a colorless gas, which can stop a person from breathing and cause death. In low concentrations it has a distinctive "rotten-egg" odor, but at high concentrations or during extended periods of exposure to low concentrations, it will deaden the sense of smell. Because H_2S is colorless and because it deadens the sense of smell at a level well below a lethal concentration, the senses cannot be relied upon for detecting the presence of H_2S. The only sure method of detecting H_2S is by using a calibrated gas detector.

There are relatively high concentrations of H_2S in the Eocene and Ratawi reservoirs; therefore it is critical to understand the hazards of H_2S, where it can be found, and what to do, if H_2S is encountered.

WJO H2S Maps

1. Health Effects of H2S

   The effects of sub-lethal exposures to H_2S are reversible and are not considered to be cumulative. If a person is exposed and recovers entirely from the exposure, successive exposures do not accumulate, and health effects will be the same as the person who has not been exposed.

   Protection from high H_2S exposure is either through engineering controls or by using personal protective equipment. These control methods are the only accepted methods to prevent exposure.

   If a person is exposed to H_2S concentrations sufficient to cause loss of consciousness or respiratory arrest, the person must be immediately removed to fresh air and given prompt medical attention (within three to five minutes) or death will result. Note: Any rescue attempt must be made by personnel wearing a SCBA or an airline respirator with an escape bottle.

2. Ignition Hazards

   H_2S in the pure state will auto-ignite at 246^{O}C and has a wide flammability range of 4.3% - 45.5% by volume. When H_2S burns, sulfur dioxide (SO_2), a very toxic gas with a pungent odor, is formed. Ignition of H_2S can be explosive under certain conditions.

   H_2S can react with iron oxides in an oxygen deficient atmosphere and form a class of substances called "pyrophoric iron sulfides". Pyrophoric iron sulfides then oxidize when exposed to air (oxygen), producing sufficient heat to ignite any flammable substances that are present.

3. Sources of H2S

   H_2S is present in all Wafra Joint Operations production and processing operations. Personnel exposure may occur from, but is not limited to, unplanned releases from wells, fuel gas system, unit processing equipment, pipelines, flare systems, produced water, waste water, spent caustic, and tank bottom sludge.

   Personnel must always be aware that exposure to H_2S can occur when carrying out routine duties such as sampling, drawing water from tanks, gauging, chemical cleaning, bleeding down lines, and opening up (and working on) equipment.

   Exposure can occur during drilling and/or working over a well and when doing wire line or other work at a wellhead.

   Hydrogen sulfide is slightly heavier than air. Therefore, if released it may accumulate inside pits, sumps, manholes, sewer collection systems, waste lines, underground structures, ditches, trenches, etc. All low-lying areas in operations and industrial areas should be suspected of containing H_2S until tested using a calibrated gas detector.

4. Non-Operator and KEPA H2S Exposure Limits

   WJO complies with KEPA and Non-Operator requirements related to H_2S and has adopted the Non-Operator Chevron occupational exposure standard for H_2S. For more information, view the Chevron H_2S Exposure Standard. Following Non-Operator Chevron H_2S standard also ensures compliance with KEPA H_2S requirements.

   The time weighted average (TWA) exposure limit for H_2S is 5 ppm.

5. Symptoms of Exposure

The table below shows the health effects due to H_2S exposures at various concentrations.

H_2S Concentration	Health Effects
5 ppm (0.0005% volume in air)	Maximum allowable exposure for 8-hours without use of a respirator that is considered safe. Obvious and unpleasant odor.
15 ppm (0.0015% vol in air)	Possible long term health effects, if exposure exceeds 15 minutes without the use of a respirator.
100 ppm (0.01% vol in air)	Unable to sense smell in 3 to 15 minutes. An atmospheric concentration that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.
300 ppm (0.03% vol in air)	Exposure for 30 minutes would result in irreversible health effects and leads to cessation of breathing, unconsciousness and possible death without rescue and artificial respiration.
500 ppm (0.05% vol in air)	Immediate dizziness; breathing stops in minutes leading to unconsciousness and death without rescue and artificial respiration.
700 ppm (0.07% vol in air)	Victim falls unconscious quickly; death without immediate rescue and artificial respiration
1000 ppm (0.1% vol in air)	Immediate loss of consciousness; death without immediate rescue and artificial respiration

4.0 Equipment and Design

6. Fixed H2S Gas Detection Systems

Fixed H_2S detection systems shall be located at Sub Centers, Main Gathering Center, well sites, drilling rigs, and throughout the operations areas at locations where high concentrations of H_2S could be present. Each system consists of control modules and gas detection sensors.

Sensors are to be strategically located where they can quickly detect and sound an alarm if there is a H_2S release. Fixed sensors should have set points triggered to alarm at 10 ppm. Deviations from this set point should be made in consultation with EHS division.

7. Personal H2S Gas Detectors / Portable Gas Detectors

Personal H_2S detectors, or badge type detectors, shall be worn by all personnel while performing work in locations operations or industrial areas with WJO. These units have an audible and visual alarm that activates at 5 ppm concentration of H_2S.

Portable gas detectors are hand carried detection equipment with an internal air sampling pump and are used to detect the presence of H_2S in confined spaces or in areas with unknown H_2S concentrations. They are used during a H_2S gas release event or at other locations where

fixed detectors are not present.

8. Warning Signs

Black and yellow "Caution - H_2S" warning signs shall be posted in all H_2S Hazard Areas. These signs are in both English and Arabic languages with a single universal sign.

9. Windsocks

Windsocks shall be mounted at work locations where H_2S could be present so they are visible to personnel and visitors at all times. Generally, windsocks should be installed on the highest structure in the area.

5.0 General Work Procedures

1. Operations Unit and Field Areas

The requirements in this section are general in nature and apply to all WJO operations units and field areas. Information and requirements for specific tasks must be obtained from the job-specific operating procedures.

2. Respiratory Protection

Breathing air equipment (e.g., air line respirator or SCBA) must be used whenever:

- work must be performed in a H_2S environment with levels higher than 5 ppm;
- personnel are conducting monitoring and the H_2S concentration is unknown;
- rescue is required for personnel.

Prior to being allowed to use breathing air equipment, the worker must have medical clearance, be fist tested on the respirator type to be used, and be properly trained to wear respiratory protection.

Cartridge and dust respirators shall not be substituted for an airline or SCBA for H_2S protection.

3. Response to Gas Alarm

If a known release of H_2S gas occurs, an alarm will sound. Upon hearing the alarm, the immediate action of all personnel must be as required by Site Specific Emergency Response Plan (SSERP). For non-operational personnel, they must go to a safe muster point, an upwind outdoor location or a designated shelter in place location. Operational personnel must perform their required duties as detailed in the SSERP.

4. Rescue and First Aid

If a case of H_2S overexposure is suspected, the first step is to contact Dispatch at 2222.

After notifying Dispatch, a rescue (removing the victim from the exposure) may be attempted. Before assisting the victim, the rescuer must don a SCBA or an air line respirator with an escape bottle. The use of MiniScapes for rescue is prohibited. All other personnel must stay out of the area where the exposure

occurred. After the victim is removed to a safe location, first aid must be administered by trained and certified personnel.

6.0 Roles and Responsibilities

Table 1: Roles and Responsibilities

Division /Group	Responsibilities	Competencies
WJO Operations/RIG/FDG	• Maintain awareness of all individuals in WJO operating areas • Provide personal H_2S detectors to all group personnel that will enter field • Provide SCBA or air-line respirators to personnel needing them to safely perform their work • Sign the work permit for any work where work will the potential to contain H_2S	Understanding of the H_2S Safe Work Practice Ability to communicate requirements and ensure compliance with H_2S Safe Work Practices
WJO EHS	• Ensure H_2S Training is available • Provide H_2S and Safety orientations for visitors	Understanding of the H_2S Safe Work Practice Ability to communicate requirements and ensure compliance with H_2S Safe Work Practices
Assigned Field Safety Engineers	• Monitor any area where there is potential for exposure to H_2S	Understanding of the H_2S Safe Work Practice Knowledge of and understand how to use a portable H_2S detector and common locations where H_2S may be found Knowledge of and understand how to use a SCBA
Supervisors	• Ensure all personnel working for them that must go to the field have completed H_2S Training	Understanding of the H_2S Safe Work Practice Knowledge of and

Role	Responsibilities	Competencies
	and a personal H_2S gas detector	understand how to use a portable H_2S detector and common location where H_2S may be found
All WJO personnel, contractors, and visitors	• Complete H_2S training or H_2S Orientation as dictated by position or purpose of field visit	Understanding of the H_2S Safe Work Practice Know how to find a safe muster location Know how to bump test personal H2S detectors
WJO Non-Operators (SAC & KGOC)	• Ensure all individuals assigned to roles in WJO, that may require the use of a respirator or SCBA, have been medically cleared and fit tested for the type of respirators to be used. • Non-Operators are responsible for providing medical testing and fit testing for any employees seconded from their organization to WJO.	Understanding of H2S Safe Work Practice Trained resources to provide medical clearance and respirator fit testing as required by this standard

7.0 Definitions

1. H_2S Hazard Areas – Any location where H_2S could be released to the atmosphere. Examples of such locations include:
   - Production areas , operational units, other industrial areas, and well sites
   - Tanks with potential for sour product/water
   - Sample points where H_2S could be released
   - Sumps and sewer openings
   - Other locations where monitoring has determined that H_2S in concentrations above 5 ppm could be present
2. Safety Watch – A person trained in the use of SCBA, use of a gas detector, and knowledge of where H_2S is commonly found.
3. Visitor – Any person that does not work in the field on a regular basis
4. Bump Test – A quick functional test for gas detection equipment, with a standard sample conducted on the detector prior to use. A bump test verifies calibration by exposing the instrument to a known concentration of test gas.
5. Portable Area Gas Detector – Handheld units used to measure concentrations of specific gases or % LEL in the immediate area. WJO models include an internal pump to sample atmosphere.
6. Personal Gas Detector – A single gas detector worn in the breathing zone as a safety device.

8.0 Records

1. Required Records

   The following records will be kept:

   - Employee H2S Training Records will be maintained by the WJO Training Center
   - Employee medical testing and fit testing records will be maintained by employee's home non-operator company
   - All contractor training, medical testing, and fit testing records will be maintained by the contractor company but may be asked for by WJO for verification.