BP OIL -- TOLEDO REFINERY

Document Type: Procedure	**Area:** **Refinery Wide**	**Procedure No.:** SAF 087
Effective Date: September 18, 2014	Hydrogen Sulfide (H_2S)	**Rev. No.:** 5
Owner: Matt Grimes	**Auth. By: D. C. Durnwald** (signature on file)	**Page** 1 of 7

SCOPE	This document serves as an overview of the refinery H_2S practices and procedures used to protect people from H_2S exposure
HEALTH **Special PPE & Special Hazards**	When concentrations of H_2S are not known, cannot be assessed, or are likely to change, supplied breathing air respirators shall be used.
SAFETY	Standard refinery PPE Safe work practices when opening valves or other equipment.
REFERENCE DOCUMENTS	✓ Process Safety Minimum Expectation No. 3.0 "Hydrogen Sulfide Processing and Handling" ✓ Operating manuals for the gas tester being used (such as Toxi-Pro/Toxi-Ltd Personal H_2S Meter and MSA Five Star Passport 4-gas tester, Solaris 4-gas tester). ✓ SAF 014 "Donning Self-Contained Breathing Apparatus"
SPECIAL MATERIALS & EQUIPMENT	Direct reading, gas testing equipment Supplied air respirators Personal H_2S meters
QUALITY	Periodic employee audits to insure knowledge of H_2S hazards and protection systems. Audits of H_2S training records.
ENVIRONMENTAL	N/A

OVERVIEW

Hydrogen sulfide (H_2S) is a colorless or light yellow-colored gas with a powerful nauseating smell of rotten eggs. The odor is a poor warning property because hydrogen sulfide exposure quickly deadens the sense of smell. The gas is heavier than air and may collect in low areas such as sewers, pits, tunnels or gullies. High airborne levels of hydrogen sulfide (between 4.3 and 46.0 percent of gas by volume in the air) may catch fire if there is a source of ignition. If the gas is burned, toxic products such as sulfur dioxide will be formed.

Toledo Refinery processes sulfur-containing crudes. This will result in H_2S production in nearly all refinery units. Closed operating systems keep H_2S inside piping and vessels, thereby minimizing the risk of exposure. Routine maintenance and/or operating tasks may require "line-breaking" rendering the previously closed system to become open. For this reason, special equipment design, and work procedures and practices are in place to minimize risk of exposure to refinery personnel and the community.

1.0 H_2S Exposure

__1.1 It is crucial that all employees recognize and understand the human body's response to H_2S gas. Refer to Table 1 for the summary of physiological effects from changing levels of H_2S concentrations.

__1.2 Workplace atmospheric H_2S concentrations must be maintained at or below regulatory limits (Refer to Table 2).

__1.3 The Control of Work process and Task Risk Assessments are used to help risk assess and document the H_2S hazards.

__1.4 Personal H_2S meters are required to be worn in all non-green zone areas of the refinery. See SAF 026 (Personal Protective Equipment Policy). The operator's knowledge of operating conditions of the unit will help guide the decision to require additional protective equipment.

__1.5 Fixed H_2S gas detection systems are strategically stationed in plant areas that have high H_2S concentration streams and/or in buildings that may contain H_2S if there is a vapor release.

Area	Location
North	Poly Plant, Unsat Gas Plant, Cat Poly Analyzer building, Nerve Center, Sat 3, Sat 5, North POD
West	SRU 1,2,3; Vent areas of Tanks 294 and 295, Coker 2, Coker 3; Analyzer buildings in SRU's and Coker 3, Sat 5, Sat 6, West POD
South	ADHT, BGOT; DHT Compressor Deck, Crude 1, West Boiler Analyzer building, Sat 2 and Sat 4 buildings, Analyzer building in the ESP, H2 Plant.
East	Analyzer buildings in: Iso 2, Alky 3, Ref 2 Areas, Alky 1 Sat bldg, Alky 2 Sat bldg, Sat 7 bldg, East POD
OM&S	Blender Sat bldg, Fluor Warehouse, WWTU Belt Press, Trailer City, LPG POD, Truck 5 POD

__1.6 Most process analyzer buildings have external alarm red lights to warn of an elevated H_2S condition.

__1.7 In the event of an emergency, personnel will shelter-in-place and shut down the intake of the building ventilation system.

__1.8 Process PODs have the ability to test the room atmosphere with direct reading gas testing equipment. This may include the MSA Passport, Draeger CMS or Gas Tec with detector tubes, and personal H_2S meters.

__1.9 Essential personnel, involved in the emergency, have supplied breathing air available inside each POD.

2.0 Safety Equipment

__2.1 Supplied breathing air packs are checked for operability and accessibility at least monthly by Asset group.

__2.2 Fixed, stationary, H_2S detectors are checked and calibrated monthly by an analyzer specialist. These are located in a variety of areas in the refinery. See section 1.5.

__2.3 Personal H_2S meters must be bump tested once within each 24 hours time of use and calibrated every 30 days. It is the responsibility of the personal meter user to insure this is done. A flashing red light will illuminate on the personal H_2S meter when it is >24 hours since the meter's last bump test. An additional bump test shall be performed following an event that alarms the meter.

__2.4 Signs depicting "Caution – Hydrogen Sulfide may be present" are posted in process areas where H_2S could exceed occupational exposure limits.

__2.5 Direct reading, gas detection equipment is available at all POD areas in order to quickly, and accurately assess small H_2S leaks.

__2.6 A traction report will be completed by the supervisor of the BP employee or the BP contact if it is a contractor employee involved for any event that causes a personal H_2S or fixed H_2S meter to alarm. The max, or peak reading will be entered into the traction report.

__2.7 The Asset group checks fire monitors monthly. Water fogging is a useful and recommended method to minimize a H_2S gas release to other units or off-site.

3.0 Training

__3.1 All personnel (employees and contractors) who enter areas where they could be exposed to H_2S streams must receive initial training on the hazards of hydrogen sulfide. BP employees will receive this in the annual mandatory/regulatory training. Contractor employees will have this training as part of their initial and annual contractor safety training.

__3.2 This training will include at least the following:

- Chemical characteristics and properties of H_2S, occupational exposure limits and the body's physiological response to H_2S.
- Methods to detect H_2S and the types of methods of alterting and warning systems in the plant.

- How to respond in the case of a personal H_2S alarm.
- The hazards of pyrophoric scale.
- Emergency procedures and escape routes.
- Lessons learned involving H_2S incidents.

__3.3 A computer-based training module is used to insure competency of understanding H_2S hazards. BP employees receive this training module followed with an electronic test. Contractor employees will receive H_2S education and answer H_2S specific questions on the contractor training written test.

4.0 Normal Operating Practices, Permits and Procedures

__4.1 The operator must have knowledge of the hydrogen sulfide-containing equipment and streams in the work area in order to adequately assess and communicate potential H_2S hazards.

__4.2 Potential hydrogen sulfide exposure shall be considered as part of the risk assessment process and documented on the Permit to Work (PTW).

__4.3 Hydrogen sulfide stream samples need to have caution labels and/or signs affixed to the sample container.

__4.4 Confined space entry atmospheric testing is performed prior to issuing a Confined Space Permit. The hazard assessment must consider a plan to control pyrophoric iron sulfide inside the vessel or equipment.

5.0 Startup and Shutdown Procedures

__5.1 Operating procedures should include areas or equipment where H_2S is present during the shutdown and start-up of process equipment.

__5.2 The Management of Change (MOC) provision of the Process Safety Management Standard requires that all process changes be reviewed prior to start-up or shutdown.

__5.3 Supplied breathing air is required for isolation blanks on H_2S streams, unless an alternative plan engineers out the H_2S hazard.

__5.4 The risk assessment indicates if there is potential for H_2S. The Permit to Work (PTW) shall contain information on respiratory protective equipment if the Task Risk Assessment (TRA) determines it to be necessary.

6.0 Emergency Release Procedures

__6.1 Emergency “safe-off” procedures are specific to each process area that handles high H_2S concentration streams.

__6.2 When responding to any release from a facility containing an H_2S stream, initial situational emergency response assessment must be done in a self-contained breathing apparatus (SCBA).

__6.3 The Toledo Refinery Integrated Response Plan provides a command system structure to assist with large H_2S release emergencies.

__6.4 The emergency alarm system will emit a 30-second attack tone followed by a pre-recorded message defining a vapor release. STOP all Hot Work and Hot Work Spark Potential. Turn off running vehicles. Listen for the public address instructions.

__6.5 If a personal H_2S meter alarms, stop work, assess wind direction, leave the area by traveling crosswind. Find a safe area remote from the release or follow an evacuation route. Notify the operator. Contact your supervisor.

__6.6 Wind direction can be assessed by windsocks and/or steam or flare plumes.

__6.7 A traction report will be submitted for a personal H_2S alarm event (See section 2.6).

Revision history

The following information documents at least the last 3 changes to this document, with all the changes listed for the last 6 months.

Date	Revised By	Changes
5/28/2014	**T. Flippin**	Updated H_2S fixed gas detection table (section 1.5) – Moved H2 plant from the East to the South because the H2 plant is being transferred from the East Area to the South Area. Administrative Change only – No MOC required.
09/18/2914	**M. Grimes**	Administrative changes – Updated CoW terminology to eCoW terminology. Covered under eCoW implementation MOC #M2014707-001

TABLE 1

Typical Physiological Responses to Hydrogen Sulfide (H_2S)

Concentration, ppm	Time	Response
0.1 – 0.5	Immediate	Unpleasant odor perceptible
10	Immediate	Threshold of eye irritation, long term exposure may produce olfactory fatigue (loss of smell)
50	1 hour	Eye and respiratory-tract irritation
100	2-15 minutes	Olfactory fatigue (loss of smell)
300	30 minutes	Maximum exposure from which one could escape without irreversible health effects
500	30 minutes to 1 hour	Dizziness, loss of sense of reasoning and balance, breathing problems within a few minutes, and unconsciousness within 30 minutes to 1 hour
700	Immediate	Quickly unconscious, breathing will stop and death will occur if not quickly rescued; artificial resuscitation required
1000	Immediate	Unconsciousness at once; permanent brain damage or death quickly occurs if not promptly rescued and given artificial resuscitation

TABLE 2

Exposure Limits to Hydrogen Sulfide

Concentration, ppm	Time	Basis for Exposure Limit
10	8 hour TWA[1]	ACGIH[2] and OSHA[5]
15	15 minute STEL[3]	ACGIH[2]
20	10 minute ceiling[4]	OSHA[5]
50	Maximum Peak[6]	OSHA[5]
100	IDLH	NIOSH[8]

Notes

1. The time weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, without adverse effect.

2. American Conference of Governmental Industrial Hygienists.

3. The short-term exposure limit is a 15-minute time-weighted average exposure that cannot be exceeded even if the 8-hour TWA is within limits. The STEL should not occur more than four times per day and there should be at least 60 minutes between successive exposures.

4. Acceptable ceiling concentrations – an employee's exposure to a substance cannot exceed the ceiling concentration during an 8-hour work sift except for a 10 minute time period providing the exposure is below the maximum peak and can occur only once providing there is no other measurable exposure.

5. Occupational Safety and Health Administration 29 CFR 1910.1000

6. Employee exposure should never exceed the maximum peak unless proper personal protective equipment is worn and administrative safety controls are in place.

7. Immediately Dangerous to Life and Health is a condition that poses an immediate threat of severe exposure to a contaminant which is likely to have adverse cumulative or delayed effects on health or prevents escape from such an environment.

8. National Institute for Occupational Safety and Health, Pocket Guide to Chemical Hazards.

THIS IS THE LAST PAGE