Hydrogen Sulfide Exposure Prevention

Purpose

HSS-404 defines the controls, safe work practices, and training requirements to minimize employee exposure to hydrogen sulfide (H2S).

Scope

This standard is applicable to Marathon employees and contractor personnel at Los Angeles Refinery who are involved in work activities where there is potential for hydrogen sulfide exposure.

Records Retention

Printed copies of this document should not be retained more than 12 months. Any revision to this document will be retained a maximum of 10 years following the revision.

Table of Contents

1.0 References

1.1 Refining References

The table below lists the Refining references used with this document.

Number	Description
HSS-501	Personal Protective Equipment
HSS-305	Hazard Communication
HLT-2001	Industrial Hygiene Program & OEH MP 24 (Downgrade Procedure)
HLT-2002	Hydrogen Sulfide Exposure Control Program
HLT-2005	Respiratory Protection Program
RSP-1701	H2S Exposure Control Program Minimum Requirements
HSS-201	Safe Work Permit
HSS-306	Respiratory Protection Program

1.2 Regulatory References

The table below lists the regulatory references used with this document.

Number	Description
Title 8, California Code of Regulations, Section 5155, Table AC-1,	Permissible Exposure Limits for Chemical Contaminants
Title 29, Code of Federal Regulations, Section 1910.1000	Air Contaminants Table Z-2
Title 29, Code of Federal Regulations, Section 1910.1020	Access to Employee Exposure and Medical Records Standard

1.3 Terms

The following terms are used in this document:

Reference: For details, see Appendix A: Terms and Definitions.

2.0 Roles and Responsibilities

2.1 All Personnel

Shall be responsible for:

a. Wearing a personal H2S monitor in accordance with Section 5.2.

b. Participating in H2S exposure assessments as appropriate.

c. Receiving awareness training on the hazards of H2S, use and limitation of personal H2S monitors, response to alarms, and required safe work practices.

d. Reporting any H2S odors detected in the plant to the 501/Refinery Shift Superintendent (RSS).

2.2 Occupational Health

Shall be responsible for:

a. Maintaining this Standard Practice.

b. Conducting air monitoring to assess employee exposure to H2S in units where H2S is a component of refinery streams. Periodic monitoring of full shift, short term, and peak exposures will be conducted by the Occupational Health group per exposure assessment plan.

c. Identifying and documenting areas that contain or are likely to contain H2S process streams. Process changes will be captured through the Management of Change process and updated accordingly.

d. Identifying jobs/tasks involving exposure to H2S that require the use of additional controls.

e. Responding to leaks, alarms, and releases where H2S may be present to provide support in quantifying concentrations, identifying sources, and determining if additional controls are needed.

f. Conducting H2S monitoring, when necessary, to further investigate recurring alarms and determine if alarm event is considered a Health-Related Incident (HRI).

g. Administering the personal H2S monitor program, tracking, and follow-up.

h. Conducting and updating on initial and refresher training on H2S Exposure Prevention. Training may be provided in the form of computer-based training (CBT).

i. Serving as a point of contact for questions regarding monitoring or PPE requirements.

j. Periodically auditing the program.

2.3 Authorized Gas Testers

Shall be responsible for:

a. Performing gas testing prior to issuing permits that allow hot work or confined space entry where potential exposure to H2S exists.

b. Determining additional controls based on gas testing results.

c. Responding to leaks or releases where H2S may be present.

d. Notifying the Occupational Health group if job scope may be an H2S exposure concern.

e. Ensuring safe work practices and personal protective equipment (PPE) identified by this procedure are followed.

2.4 Operations and Maintenance

Shall be responsible for:

a. Awareness of the refining processes and process streams that can present an H2S exposure hazard and work practice controls to mitigate exposure potential.

b. Awareness of H2S hazards associated with exposure and identifying the work practice controls listed in Section 3.1 necessary for performing or permitting work.

c. Wearing personal H2S monitors and following requirements for bump testing and monthly calibration, maintaining and/or replacing monitors.

d. Adhering to work practice controls applicable to the job task being performed and wearing proper respiratory protection and PPE as required in Section 4.5, Table 6 or as identified as part of the SWP.

e. Notifying the Health group of new or non-routinely performed tasks that may present an exposure to H2S.

f. Reporting personal H2S monitor alarms to supervision and submitting appropriate notifications per Section 3.5.

g. Operations only: Investigating H2S monitor alarms that occur in their area and determining if actions required to isolate the source of H2S require SAR or SCBA respiratory protection, and/or emergency response assistance (see section 3.5.2).

2.5 Electrical Instrumentation Department

Shall be responsible for:

a. Calibrating and maintaining fixed H2S area monitors located in various process areas throughout LAR.

b. Maintaining logs for preventive maintenance.

2.6 Operations Support Engineering

Shall be responsible for:

a. Coordinating sampling of refinery streams for analysis by the LAR Laboratory to quantify concentration of H2S in the stream.

- This information shall be supplied to the Occupational Health group for inclusion in applicable Safety Data Sheets (SDS).

b. Ensuring changes are captured through the Management of Change (MOC) process when a process change impacts stream composition of H2S.

- Process changes may require equipment labeling and orange color coding changes to meet H2S identification requirements

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2.7 Engineering

Shall be responsible for:

a. Ensuring design considerations for new or modified equipment in H2S streams. These may include but are not limited to:

- Proper metallurgy
- Closed sampling systems
- Welded connections up to the first block valve
- Relief valve systems discharge to flare
- Process sewers and drains properly vented to approved locations

- Assessing need for double or tandem seals on pumps in H2S stream service
- Proper shaft seals for compressors
- Continuous monitoring and alarm systems for:
- Analyzer buildings
- Process units
- Laboratories
- Air intake stacks

b. Other Marathon or Industry standards may also be applicable. Consult the Marathon Corporate Engineering Group for comprehensive information on design of equipment in H2S stream service.

2.8 Contractor Personnel

Shall be responsible for:

a. Providing their own personal monitors and calibration stations and shall wear monitors in accordance with Section 3.2.

b. Contractor monitors must have the capability to capture peak H2S concentrations so that peak reading can be identified and recorded as necessary.

c. Each Contractor must have procedures for the maintenance, bump testing, calibration (if required by the Manufacturer) and recordkeeping of all Contractor personal monitors.

d. Adhering to alarm reporting requirements in section 3.5 by evacuating area, immediately reporting personal alarm to operations permit writer, contractor supervision, and Safety for follow-up and clearance to continue work.

e. Adhering to work practice controls applicable to the job task being performed and wearing proper respiratory protection and PPE as required in Section .5, Table 6 or as identified as part of the SWP.

2.9 Safety Issue

Shall be responsible for:

a. Issuance, maintenance, troubleshooting, and replacement of LAR personal H2S monitors and docking stations.

3.0 Procedure

3.1 Safe Work Practices

3.1.1 Identification of H2S-containing Process Streams

1. Existing flanges on piping and equipment containing process streams which contain 500 ppm or greater H2S are painted orange at Carson

    a. "Acid Gas" piping running from the North and South Area Amine units to feed the Carson Sulfur Plant contains more than 90% H2S and is painted orange along the entire pipe run

Note: This is an indicator and shall not be relied on solely.

2. Sign postings in specific locations alert personnel of the potential presence of H2S for specific equipment and pits.

3. Table 4 in Section 4.3 and Table 5 in Section 4.4 identifies process stream locations containing H2S greater than 0.1%. Associated process stream locations and equipment can be referenced electronically via the online SDS system.

3.1.2 Examples of Engineering Controls for H2S Equipment

1. Closed-system sampling stations.
2. Tandem seals on pumps handling H2S process streams
3. Exhaust hoods
4. Vapor Collection systems
5. Sewer enclosure, closed drain headers
6. Relocation of control valves remote from draining site

3.1.3 Examples of Work Practices Controls for H2S Equipment

1. Equipment isolation from the source of H2S
2. Equipment preparation by Operations (steaming, draining, flushing, scavenger chemicals, etc.)
3. Portable Ventilation
4. Limiting access, barricades
5. Training
6. Respiratory protection

7. Standing upwind

3.1.4 Interim H2S Exposure Controls

Interim measures may be required while engineering controls are being developed and implemented. Examples include:

1. Respiratory protection will be used in the interim when engineering controls and work practices are being installed or implemented.

2. The Health Department must be involved during the hazard assessment of the design process to ensure all H2S control measures are adequately implemented.

3. The Health Department must be notified when new H2S control equipment is installed, or old H2S control equipment is modified that could affect an employee's exposure levels.

3.2 Personal H_2S Monitors

3.2.1 Personal H_2S Monitors

1. A personal H2S monitor does NOT provide any type of protection against H2S. Do not use personal H2S monitors as leak detectors. A multi-gas monitor can be used for this purpose.

Note: Multi-gas monitors can be obtained from an Operations foreman or Health & Safety representative.

2. Personnel working in process areas where unit sign-in and sign-out is required shall wear a personal H2S monitor.

3. Individual H2S monitors are not required for escorted site visitors when accompanied by an MPC employee(s) with a monitor.

4. Exemptions to the requirement for wearing a personal H2S monitor include the following units and tasks:

    a. SCBA/SAR Tasks

Note: Area where SCBA/SAR is used must be barricaded a minimum of 25 feet beyond impacted area based on gas test results and wind direction to prevent unprotected entry. Monitor should be placed outside the barricade until task is complete.

    b. Asbestos work

c. Hydroblasting activities

d. Fire Brigade response

e. Delivery drivers not performing work inside of a process unit

f. Carson-specific Locations

i. Blue Barn

ii. Wilmington Calciner

3.2.2 Monitor Requirements

1. The approved personal monitor for Marathon LAR personnel is the Industrial Scientific Tango.

2. Personal monitors shall be set to alert at 10 ppm, alarm at 20 ppm (low alarm) and 50 ppm (high alarm).

3. Monitors shall be minimally equipped with both latching audible and visual signals to alert the user when alarm set points have been exceeded. Audible alarm will not clear until monitors are docked on the docking station.

4. Monitors shall have the ability to download data on a docking station, and docking stations shall be made available for calibration, bump testing, and downloading alarm data.

5. An amplifier attachment to increase the audible alarm level for the Industrial Scientific Tango monitor is available and stocked at the storehouse.

3.2.3 Monitor Replacements

1. Monitors shall be worn within 12 inches of the breathing zone and placed in a way where it does not hinder line of vision.

2. Monitors can be worn on the side of hard hats but not on the back.

   a. If working in high noise areas, monitors without amplifier attachment must not be placed on the hard hat to ensure visual alarm can be seen.

3. Monitors cannot be worn on belts on the waist or back. Do not attach monitor to radios.

a. Any exemptions to the placement of the monitor shall be approved through the Medical Department.

4. The sensor shall not be obstructed by garments, decals, or tape.

5. Monitors shall be worn on the outermost layer of clothing.

3.2.4 Issuance to Marathon Employees

1. Personal monitors are issued by Safety Issue after personnel receive training on the monitor and intended use.

    a. Monitors can be marked for identification purposes, however, do not use decals that will obstruct the sensor or display window

2. Non-functioning monitors shall be returned to Safety Issue for replacement. Non-functioning monitors shall not be disposed of as waste.

3. Replacements or loaner monitors can be obtained from Safety Issue after completing the form in Appendix E.

    a. Occupational Health approval is required to assign temporary personal H2S monitors to visitors and agency employees.

    b. Contact the 501/Refinery Shift Superintendent (RSS) for after-hours issuance.

3.2.5 Monitor Maintenance

1. Monitors shall be docked every shift worked, and after any alarms occurring in the field per instructions located at each docking station.

2. Monitors shall be calibrated at least once per month.

3. To ensure the proper functioning of the monitor after dropping or liquid contact with the sensors, the monitor shall be docked to determine if sensors have been impacted. If docking station shows any error message, return monitor to Safety issue for a replacement.

4. If monitor does not pass calibration or bump testing, the monitor shall be replaced immediately. Monitor replacement or troubleshooting can be obtained at Safety Issue.

3.3 Fixed Location H_2S Monitors

3.3.1 Fixed Location H_2S Monitors

1. Refer to standing instruction SAF-066, Fixed Area Monitors.
2. Fixed area monitors are typically located in or near process areas where H2S releases are likely to occur. The locations are chosen based upon the H2S content in a process stream and its associated hazard potential should there be an equipment leak or failure.
3. Additional locations may be determined based on Process Hazard Analysis (PHA) and Incident Investigations.
4. Monitors shall be utilized and maintained as the primary means of detecting and warning of potential H2S releases that may pose a hazard to employees.
5. Fixed area alarms shall be reported through the Intelex Report form.
6. Fixed monitors are set to alarm as low as 10 ppm and are maintained by the Electrical group (Carson) and the E&I group (Wilmington).

3.4 Respiratory Protection Requirements

3.4.1 Respiratory Protection Requirements

1. Supplied air respirators may be SAR or SCBA and are required in unknown H2S environments or where H2S concentrations are above IDLH, can change rapidly or controls do not reduce concentrations to below meter alarm set points or for invasive work requiring (RAM Mitigation Level 1). All personnel using these respirators shall have a standby present with a SCBA available in case of emergency. Standby personnel will be required to wear a SCBA on their back with the mask out of the plastic wrap and ready for use.
2. Personnel using SAR should remove their H2S monitor and place it outside the barricaded area until task is complete and checked for any levels before removing SAR.
3. If H2S Alarm occurs while in supplied air after retrieving meter or if not removed before starting task, the incident shall be entered into the Incident Tracking Database noting the employee was wearing SAR.

4. Air Purifying Respirators (APRs) for H2S are allowed for a specific task of known H2S concentrations only if approved through the EXAM Process referenced in HLT-2001 and OEH MP 24 (Downgrade Procedure)

5. APRs may be worn to prevent H2S exposure in situations where breathing air is not required but H2S is identified as a potential hazard (i.e., RAM Mitigation Level 2 or 3 based on H2S gas testing verification for invasive work) or as an upgrade from no respiratory protection. APRs will be used for escape only purposes when used in this manner with the following additional requirements.

    a. A Personal H2S Monitor set to alarm at 50 ppm or **lower** must be worn within the breathing zone.

    b. If a H2S alarm occurs, treat the alarm as a normal H2S alarm. Evacuate the area and contact the operator/shift foreman. The incident shall be entered into the Incident Tracking Database noting the employee was wearing an APR.

    c. APRs cannot be used for H2S concentrations above 100 ppm.

    d. APR cartridges must be changed out monthly at a minimum and after each alarm event.

6. Examples of job tasks requiring respiratory protection (SAR and APRs) are listed in Section 4.5 Table 6.

3.5 Alarm Reporting

3.5.1 Alarm Reporting

1. Follow flowchat in Section 5 for response to a personal H2S monitor alarm.

2. Report and document all alarm events, peak readings and activity being performed at the time of the alarm event to unit operations and foreman for your craft or department.

    a. Personnel must be medically evaluated if the peak reading reaches a H2S concentration of 100 ppm or greater without respiratory protection and 200 ppm if wearing an APR or if any exposure symptoms listed in Table 3 are experienced.

    b. Employee's supervisor or designee shall document alarm events, peak readings, and activities by completing the H2S Alarm Report in Intelex.

        i. Only one (1) Intelex report is required per event and can contain multiple alarms for employees whose monitor alarmed during the event.

        ii. Only the highest peak reading of all the alarms needs to be documented on the report. See Section 8.0 for Intelex reporting steps.

        iii. Alarm events from bump testing and calibration procedures do not have to be documented.

    c. If SAR or APR is worn for the task, an Intelex H2S Alarm Report is still required to identify the trigger for the alarm noting respiratory protection was being worn.

    d. See **Table 1a** below for Alarm Levels and Incident Investigation Category.

Table 1a	Peak H2S Alarm Level	Intelex Incident Report	Investigation Category (see note)		
Respirator Type		Applies to all Respirator type categories	None	APR	SAR
Contractor	10 to 19 ppm	**Yes**	**N/A**		
	20 ppm plus	**Yes**	**Same as MPC Employee**		
MPC Employee	10 to 19 ppm (Alert)	**No Complete Chirp Log**	**N/A**		
	20 to 49 ppm	**Yes**	**Cat 1**	**Cat 0**	**Cat 0**
	50 ppm to 99 ppm	**Yes**	**Cat 2**	**Cat 0**	**Cat 0**
	100 to 199 ppm	**Yes**	**Cat 2**	**Cat 1**	**Cat 0**
	200 ppm plus	**Yes**	**Cat 2**	**Cat 2**	**Cat 0**

Note: Investigation categories can be adjusted through the refinery vetting process and circumstances associated with each alarm event. If it is found that an alarm event was already investigated or incidental (e.g., sample station, opening bleeder, interference) and the alarm event has an immediate known root cause that **does not** require further investigation, then the refinery leadership may choose to reduce the level of investigation (i.e., Category 2 to Category 1 and Category 1 to 0) by noting this in the incident report.

3. OSHA Maximum Peak

   a. Since the OSHA Maximum Peak for H2S is 50 ppm, employees who are exposed to 50 ppm or greater without appropriate respiratory protection must be protected from additional H2S exposure for the remainder of that work shift.

   b. Protection can Include:
      i. Reassignment for the remainder of the shift to a job or task with limited exposure to H2S,

         a. Job tasks with potential to expose employees to H2S are listed in Table 6.

      ii. Replacement by another qualified worker, or

      iii. Continuation of normal duties with the recognition that any job that has the potential for

H2S exposure must be performed in SAR or by another qualified worker

3.5.2 H2S/Release/Leak Alarm Response

1. Upon audible or visual alarm activation, stop work and evacuate the area cross or upwind of fixed monitor by checking wind direction
2. Report alarm to Operations personnel. ALL personnel shall immediately evacuate upwind and leave the unit in an orderly manner.
3. Operations personnel shall don unit SCBAs before returning to the unit to investigate and correct the source of H2S release or leak.
4. A trained employee wearing a SAR shall conduct air monitoring immediately after the incident to determine airborne concentrations of H2S and determine the following:
    a. The level of PPE that must be worn by employees responding to the incident.
    b. Establishment of temporary exclusion zones.
    c. Clearance monitoring to determine when the event is over.
5. Air monitoring shall be conducted during the response activities to assess changing conditions as well as employee exposure.
6. Small incidental releases where the source of the H2S is readily apparent (e.g., sample station, opening a bleeder) may not require all the actions in section 4 and 5 above.
7. Maintenance and contractor personnel shall not return to the unit until advised by Operations personnel that it is safe to do so.
8. If it the source of the H2S release or leak cannot be located or isolated, then an H2S emergency exists.
9. If it is determined that an H2S emergency exists and the detection system alarm has not sounded, then Operations personnel shall activate the unit call horn to sound an emergency alarm.

3.5.3 Alarm Interferences

1. Interferent materials may give an inaccurate gas reading and/or cause the monitor to alarm. It is important to understand these potential interferences, but **do not** assume the alarm is a false reading. Respond as if it is an accurate reading and reassess the situation.

2. A colorimetric diffusion detector tube can be used to verify and confirm positive interference.

Note: Interferent alarms may still warrant additional follow up with an Authorized Gas Tester, Health, or Safety with the use of multi-gas meters or colorimetric detector tubes.

3.5.4 **Potential Interferences include:**

1. Isopropyl Alcohol
2. Hydrogen Gas
3. verify with a colorimetric detector tube for H2S or Hydrogen
4. C3-C4 light hydrocarbon vent gases that do not contain H2S.
5. Diesel Exhaust – from the oxides of nitrogen (NOx).
6. Radiofrequency (RF) transmittal

3.6 Training

3.8.1 Training

1. Annual refresher training is provided in the form of computer-based training (CBT).
2. MPC personnel issued personal H2S monitors shall be trained in the hazards of H2S, equipment use, and limitations through classroom training.
3. Contractors required to wear personal H2S monitors are trained on site specific requirements through the contractor site specific safety orientation.

3.7 Auditing

3.7.1 Auditing

1. Adherence to section 5.2 for contractors and employees is included as part of the Safety Field Audit system
2. Adherence to meter calibration requirements is conducted through monthly reporting of overdue calibrations
3. Review of alarm incident causes/mitigations is conducted and communicated through safety sequential monthly meetings

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3.8 Management of Change (MOC)

3.9.1 Management of Change

1. As new information regarding the health hazards associated with exposure to H2S become known, or as regulations or exposure guidelines change, the Occupational Health Group will communicate information to personnel through training sessions or other appropriate means.

2. As unit processes change and/or as new units come online, and as more analytical information is determined, the SDS and associated Equipment Table will be updated to reflect the changes in H2S content in refinery streams and location of these streams. These changes will be part of the MOC reviews.

3.9 Record Keeping

3.9.1 Record Keeping

1. All records associated with this Standard and the implementation of this Standard shall be maintained in accordance with Marathon Petroleum Corporation Enterprise Records and Information Management Policy (MPC6003).

2. Training records are maintained by the Training Department.

4.0 Table List

4.1 Table 2- Physical Characteristics of H2S

Molecular Formula	H_2S
Specific Gravity	1.189 (Air = 1)
Flammability	Flammable
Ignition Temperature	500ºF
Explosive Range	4.3% to 46% by volume in air

4.1.1 Hydrogen sulfide (H2S) is an extremely toxic substance. H2S is slightly heavier than air and may accumulate to dangerous concentrations in low-lying areas and confined spaces, thereby causing asphyxiation. H2S burns readily with a blue flame and produces sulfur dioxide. It also forms explosive mixtures with air.

4.1.2 H2S is water soluble and can be carried in water streams through the sewer system. Since it is highly reactive with oxidizing materials such as chlorine and peroxides, H2S can be released from water or caustic streams by the combination of heat and acids. For this reason, the potential exists for H2S evolution from any open sewer connection.

4.1.3 H2S has a very low odor threshold below 1 ppm. The ability to detect the classic “rotten egg” odor can easily be lost at relatively low concentrations.

4.1.4 This gas does not have adequate warning properties because olfactory fatigue sets in after prolonged exposure starting at 100 ppm. Olfactory fatigue is the temporary inability to distinguish a particular odor after (1) a prolonged exposure to that odor or (2) an exposure to a “threshold” concentration of that odor. After leaving an area of “elevated” odor, olfactory sensitivity is restored with time.

4.2 Table 3- Exposure Concentrations and Health Effects from H2S Exposure

Concentration (ppm)	Health Effects
0.01 – 0.3	Odor threshold (highly variable)
1 – 5	Moderate offensive odor, may be associated with nausea, tearing of the eyes, or headaches
20	Odor very strong; conjunctivitis may occur
20 – 50	Conjunctivitis and lung irritation
100	Eye and lung irritation; olfactory paralysis, odor disappears
150-200	Sense of smell paralyzed; severe eye and lung irritation
500	Serious damage to eyes within 30 min; severe lung irritation; "knockdown" and asphyxiation
1000	Breathing may stop within one or two breaths: immediate collapse
Source: 2015 Hamilton & Hardy's Industrial Toxicology, Sixth Edition	

4.3 Table 4- Carson Process Streams Containing Greater Than 0.1% H2S

Process Stream/SDS Name	%Low	%High	Process Areas
Water Saturated Ammonia-Hydrogen Sulfide Gases	0.10%	0.70%	Sulfur Unit
Amine Gas, High H2S	90.00%	98.00%	Coker, FCC/#4 Steam Plant, SFIA, Sulfur Unit, Waste Water
Acid Scrubber Off Gas	30.00%	80.00%	Sulfur Unit
Refinery Fuel Gas,Vapor/Flare Gas Recovery/Sour Refinery Gas (Replaced RS 018)	0.02%	60.00%	#1Ref/HDS, #2/#3 Reformer, Alky Complex, Coker, Crude/Vacuum Units, Isom Complex, FCC/#4 Steam Plant, Hydrocracker, SFIA, FGR, Sulfur Unit and Waste Water
Hydrogen Rich, Sour Refinery Gases (RS 041)	0.01%	8.00%	Hydrocracker, Isom Complex, #1Ref/HDS, #2/#3 Reformer, FCC/#4 Steam Plant, SFIA
Main Reactor Furnace Effluent	0.00%	19.00%	Sulfur Unit
Sulfur Plant Gas	0.10%	3.00%	Sulfur Unit
Merox Unit Foul Air	0.00%	5.00%	Alky Complex, SFIA, Sulfur Unit, Waste Water
Butane-Propane with H2S	0.00%	1.00%	Isom Complex

Distillate with Sulfur, Benzene	0.00%	1.00%	Hydrocracker
Sour Naphtha/Hydrogen Mixed Phase Refinery Stream	0.00%	2.00%	#1Ref/HDS, #2/#3 Reformer
Refinery Mixed Slops	0.00%	1.00%	Coker, Storage & Handling
Sour Crude Oil (High H2S potential)	0.10%	0.50%	Crude/Vacuum Units, Storage & Handling
Spent Sodium Hydroxide Solution	0.10%	0.70%	Alky Complex, Cogen, Crude/Vacuum Units, FCC/#4 Steam Plant, SFIA, Storage & Handling
Sour Water	0.00%	0.70%	#1Ref/HDS, #2/#3 Reformer, Alky Complex, Coker, Crude/Vacuum Units, Isom Complex, FCC/#4 Steam Plant, Hydrocracker, SFIA, Storage & Handling, Sulfur Unit, Waste Water
Rich Amines	0.10%	0.70%	#1Ref/HDS, #2/#3 Reformer, Coker, FCC/#4 Steam Plant, Hydrocracker, Isom Complex, Sulfur Unit

4.4 Table 5- Wilmington Process Streams Containing Greater Than 0.1% H2S

Process Stream/SDS Name	%Low	%High	Process Areas
Acid Scrubber Off Gas	30.00%	80.00%	Los Angeles Refinery (LAR)
Spent Caustic Solution	0.10%	0.70%	Alky, C4 Isom, CRU-2, All, ETD, FCCU, RP&S, SRP
Coker Injection Sludge	0.00%	0.10%	LAR
Sour Heavy Crude Oil	0.10%	0.50%	BWTU, Crude, RP&S
Sour Light Crude Oil	0.10%	0.50%	BWTU, Crude, DCU, RP&S
Decant Oil	0.00%	0.10%	LAR, RP&S
Heavy Distillate	0.00%	<0.10%	Crude, DCU, FCCU, HCU, HTU-4, RP&S
Sour Refinery Fuel Gas/Vapor Recovery/Flare Gas	>162ppm	12.5%	Alky, Crude, LAR, Bensat, CRU-2, CRU-3, DCU, FCCU, FGR, HTU-2, HTU-3, HTU-4, SP&W and SRP
Hydrogen Sulfide	90.0%	100%	Alky, CRU-3, DCU, GCP, HCU, HGU-1, HTU-1, HTU-2, HTU-3, HTU-4, SRP
Lean Amines	0.00%	0.1%	LAR

Merox Unit Foul Air		<5.00%	LAR
Untreated Naphtha	0.00%	0.10%	LAR, HCU, SRP,
Rich MDEA in H2S Service	0.00%	6.00%	SRP, LAR,
Heavy Slop Oil	0.00%	1.00%	LAR, Crude, DCU, ETD, HTU-4, RP&S
Light Slop Oil	0.50%	0.75%	LAR, FGR
Sour Water with H2S		<1.00%	Bensat, LAR, Crude, CRU-2, DCU, ETD, FCCU, FGR, GCP, HCU, HTU-1, HTU-2, HTU-3, HTU-4, RP&S, SRP
SRU Tail Gas	0.00%	10.00%	LAR
Stripped Sour Water	0.00%	0.10%	BWTU, LAR, DCU, ETD, HCU
Spent Sulfuric Acid			Alky

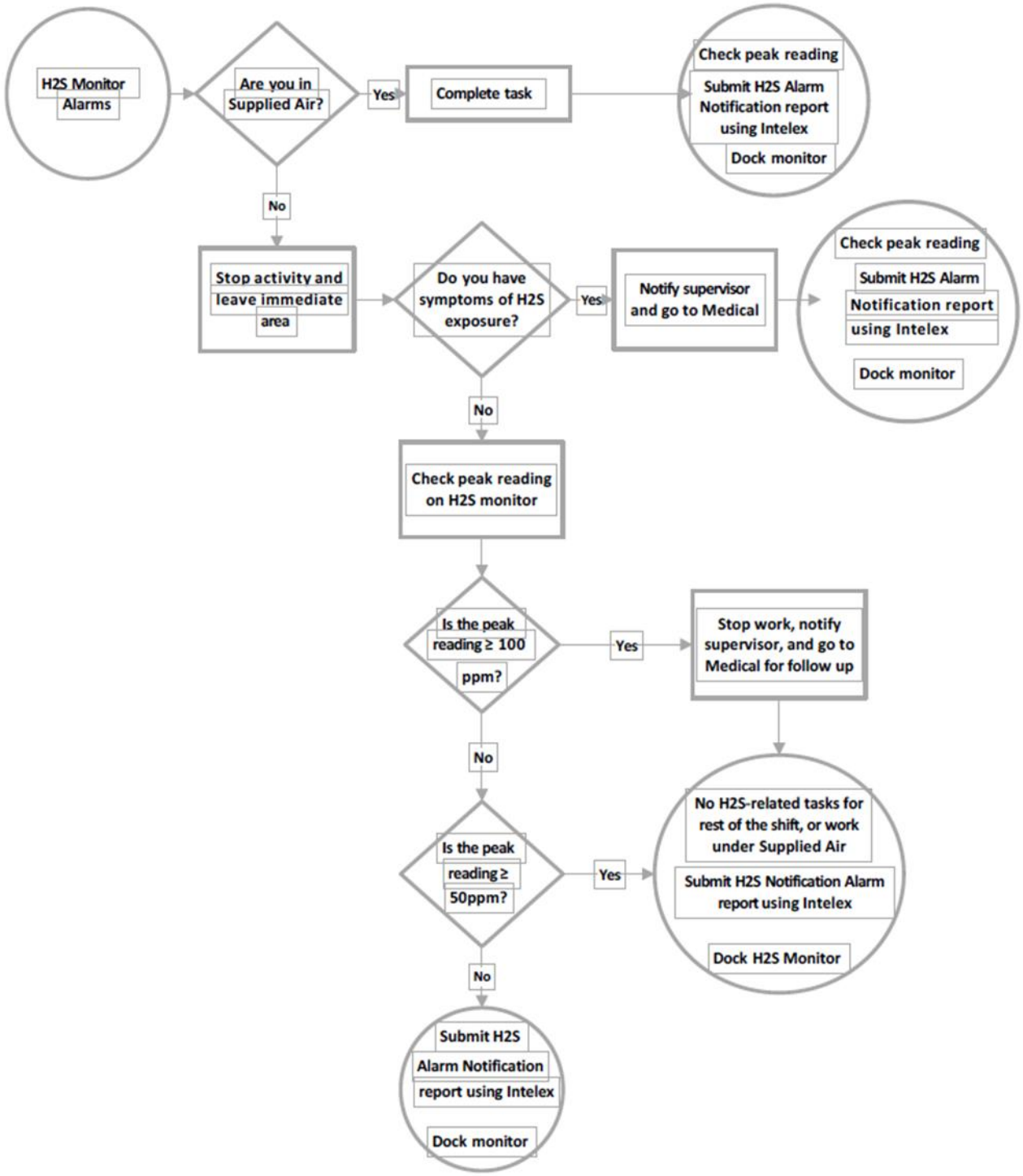
4.5 Table 6- Examples of Job Tasks and Respiratory Protection Requirements

Job Type	Job Task for H2S Equipment	Minimum Respiratory Protection
Sampling and Depressuring H2S Streams from process equipment	Check the wind direction prior to collecting a sample or depressuring H2S equipment and stand upwind.	Readjust and stop if monitor alarms or in Air Purifying Respirator(APR)with multi gas olive/magenta cartridge for Escape
Top Heading Coke Drums	Unbolting Top Head through drilling pilot	APR with multi gas olive/magenta cartridge for Escape
Cleaning coke drum condensate accumulator pump suction strainer baskets	Opening and removing plate cover after depressuring	APR with multi gas olive/magenta cartridge for Escape
Disconnecting hoses	Disconnecting hoses from process equipment in H2S service after purging residual material to vapor recovery	APR with multi gas olive/magenta cartridge for Escape
Loading or sampling molten sulfur from the dome/hatch of a sulfur truck	Check wind direction and use blowers to direct vapor away from breathing zone	APR with multi gas olive/magenta cartridge for Escape
Invasive Work (Blinding/Line Breaks)	Blinding and opening equipment in H2S service as indicated by	Supplied Air Respirator (SAR)

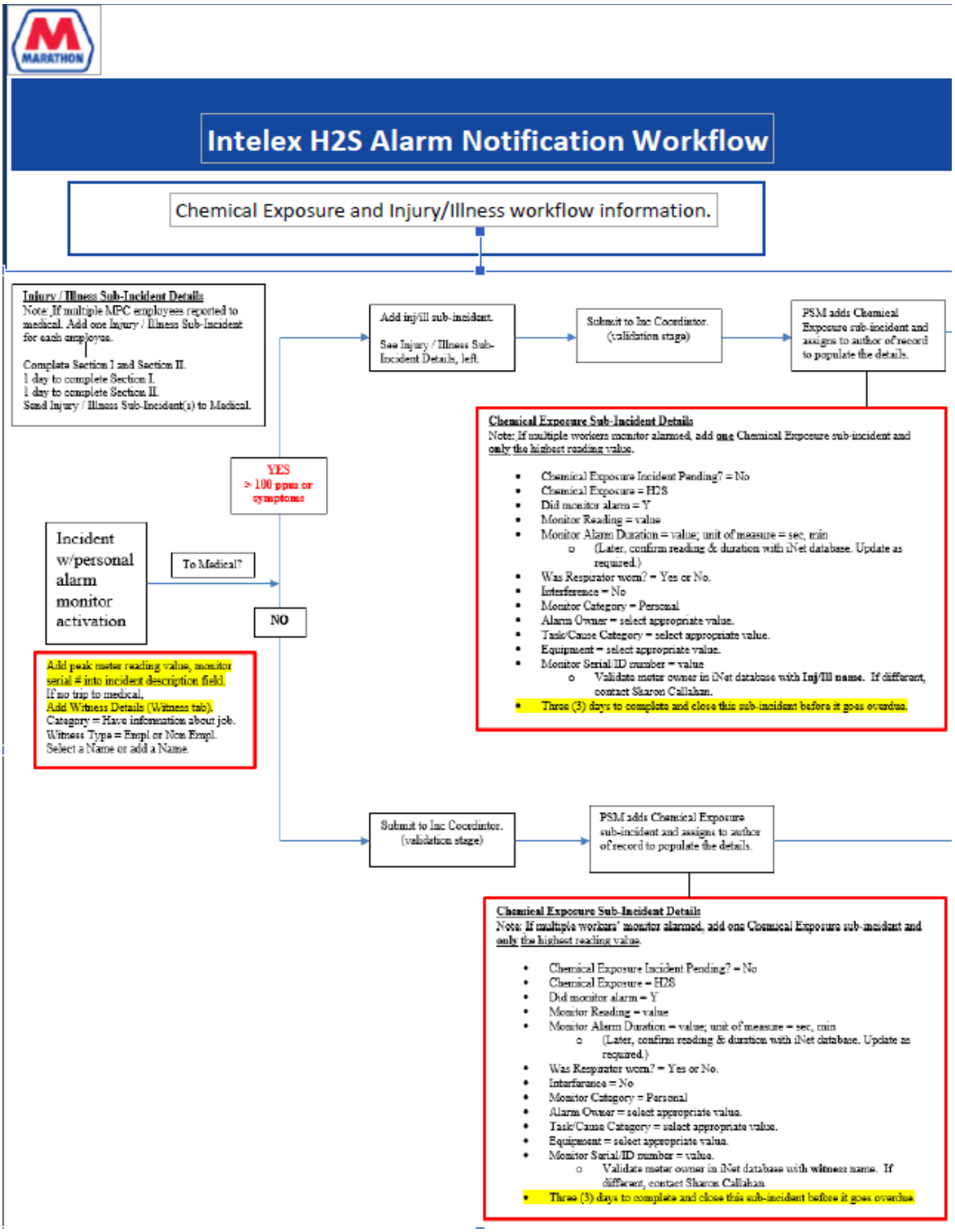
	process stream or RAM Mitigation Level 1	
Invasive Work (Blinding/Line Breaks)	Blinding and opening equipment in H2S service as indicated by process stream or RAM Mitgation Level 2	APR with multi gas olive/magenta cartridge for Escape
Equipment Leaks/Releases	Tightening up or responding to leaks/releases on equipment in H2S service as indicated by process stream	SAR
Tank Roof Activities	See Form T 04 - Tank Roof Access Form	
Work activities identified through Risk Assessments	Tasks on equipment in H2S service as indicated by process stream	See Note 1 -SAR
Incident Response	Responding to an uncontrolled release of an H2S containing stream	SAR
H2S Alarms triggered by any activity	Continuing task with an alarm that has not stopped by repositioning and/or closing off source	SAR
Fixed H2S Monitor Alarms	Investigating fixed monitor alarms	SAR

Note 1: If properly isolated, steamed, cleaned, or purged, a direct read gas test by an authorized gas tester, Health/Safety Department may lower the level of respiratory protection required, and shall be documented on the permit.

5.0 ALARM EVENT FLOWCHART



6.0 INTELEX H2S ALARM NOTIFICATION WORKFLOW



7.0 PERSONAL H2S MONITOR SSIGNMENT/REPLACEMENT FORM

Request for H_2S monitor: ϒ Visitor ϒ Replacement Monitor ϒ Temporary Loaner* ϒ New

Employee/Visitor Name:_____ **Date:** _____

Employee #: _____ **Company/Agency:** _____

Job Title: _____ **Department/Unit:** _____

Supervisor: _____ **Phone #:** (_____) - _____

Marathon Representative/Escort: _____

Email:_____

Reason for Request: ϒ Lost ϒ Forgot ϒ Error ϒ No Power ϒ New employee**/assignment

Pleasedescribewhathappenedtoyourpreviousmonitor:

_____

_____

Length of Issuance: ϒ Permanent ϒ 1 -3 Days ϒ Temporary (1 shift) ϒ Other_____

Serial Number of Monitor Assigned:

*** Loaner monitors must be returned to Safety Issue within 72 hours of temporary issuance.**

I have received and reviewed Hydrogen Sulfide Exposure Prevention Program (HSS-404) which contains instructions for monitor use and alarm response.

Employee/Visitor Signature:

_____

Appendix A: Terms and Definitions

Term	Description
Breathing Zone	The area within a one-foot radius of the mouth and nose
Bump Test	Exposing a H_2S sensor to a concentration of H_2S known to be above the alarm point to make sure the sensor is working properly.
Calibration	Introduction of a known concentration of H_2S and adjustment of the instrument as needed for proper response and accurate reading.
Facility	Buildings, containers, or equipment which contain a process.
Fixed H_2S Detector/Monitor	A stationary monitoring device, normally located in a process area, sour gas facility, analyzer shelter, air intake stack or duct which detects high levels of H_2S and displays a visual indication of H_2S detected and audible warning.
Hydrogen Sulfide (H_2S)	A colorless and **highly toxic** gas that is also extremely soluble in water and liquid hydrocarbons. A natural component of crude oil and a by-product of some refinery processes. Depending on concentration, H_2S can be explosive, flammable, or corrosive, and is dangerously reactive with other chemicals. H_2S can be detected by its characteristic 'rotten egg' odor at low concentrations in the part per billion ranges, but because it temporarily deadens the sense of smell, odor is not an adequate means of detecting H_2S presence. CAS Registry number 7783-06-4.
H_2S Stream	For the purpose of this document, a hydrogen sulfide stream is defined as any gas, vapor or liquid that can release 10ppm or more of H_2S into the breathing zone or into an area that may become the breathing zone of employees.
High H_2S Unit	Operating units or bulk storage areas that contain streams or materials that meet the H_2S Stream definition. Such areas may include but are not limited to: • Catwalks and inside of dikes around sour tanks • Floating roofs of tanks containing or previously containing crude oil, slop oil, sour water, high sulfur fuel oil or any material with detectable H_2S • Areas around gauging hatches or other openings on fixed roof tanks containing sour material • Sour or foul water stripper units, amine units and sulfur plants • Tail gas (Beavon-Stretford) open reaction/regeneration tanks • Sour gas or recycle gas compressors • Process units that handle hydrogen sulfide streams

Term	Description
Immediately Dangerous to Life and Health (IDLH)	The lowest atmospheric concentration of any toxic, corrosive, or asphyxiating substance that poses an immediate threat to life or would cause irreversible adverse health effects or would impair an individual's ability to escape from a dangerous atmosphere. NIOSH IDLH is 100 ppm. Note: The IDLH value is based on the consequence that might occur after a 30-minute exposure and every effort should be made to exit immediately.
Job Hazard Analysis (JHA)	A technique to identify existing and/or potential hazards of a specific job or task that is performed prior to beginning the job. A completed JHA will include practices to eliminate, mitigate or control any identified hazards of the job/task.
National Institute for Occupational Safety and Health (NIOSH)	U.S. federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH is part of the Centers for Disease Control and Prevention (CDC) in the U.S. Department of Health and Human Services.
Occupational Exposure Limit (OEL)	The allowed occupational exposure for Marathon employees based on Marathon's use of industry best practice and/or Marathon's risk tolerance. OEL for an 8-hour shift is 10ppm.
Occupational Safety and Health Administration (OSHA)	A division of the U.S. Department of Labor that serves as the main federal agency that sets and enforces health and safety rules for workplaces.
Parts Per Million (ppm)	Concentration of air contaminant per million parts of air
Personal H_2S Monitor / Alarm	Gas detectors for personal use, small enough to be clipped onto exterior clothing. Personal alarms alert personnel to presence of the toxic gas they were designed to detect in the local atmosphere. They provide continuous, direct reading gas detection with visual and audible alarms, and are designed to be worn when working in locations where toxic gases might be released. The terms personal H_2S monitor and personal H_2S alarm are used interchangeably.

Term	Description
Exposure Limits 1. Permissible Exposure Limit (PEL) 8-hour Time Weighted Average (TWA) 2. Short Term Exposure Limit (STEL) 15-minute TWA 3. Ceiling 10-minute TWA 4. Maximum Peak 5. Immediately Dangerous to Life and Health (IDLH)	The maximum concentration of an airborne contaminant to which a worker may be exposed averaged over a period of time. 1. H2S concentration of 10 ppm – Cal-OSHA and MPC 2. H2S concentration of 15 ppm – Cal-OSHA and MPC 3. H2S concentration of 20 ppm – Cal-OSHA and MPC 4. H2S concentration of 50 ppm if no other measurable exposure occurs during the work shift – Cal OSHA and MPC 5. H2S concentration of 100 ppm – NIOSH and MPC

Revision History

Document Revision History

Complete the following table for each document revision.

Summary of Changes	Changes Completed by:	Approved by:	Date
LAR procedures (SAF016 and FS 450) were integrated to create HSS-404. A "Contents" table has been added to help direct procedural inquiries more directly to the appropriate section and page. The "Definitions" section has been expanded to include terminology from the corporate standard TSHS-204. Section 4.0 has been updated to specify responsibilities for alarm reporting to all personnel Section 5.0 updated to include the approved personal H2S monitor for LAR personnel, removal of placement of H2S monitors on hard hats without medical exemption, and specific alarm reporting instructions. Appendix now includes: - Updated Exposure Concentrations and Health Effects table - Wilmington Process Streams Containing Greater than 0.1% H2S table - Updated Job Tasks and Respiratory Protection Requirements table - Updated Alarm Event Flowchart - Updated H2S Alarm Notification Report - Updated Personal H2S Monitor Assignment/Replacement Form	Pearl Lee	Sharon Callahan	8/3/2016
Updated 5.5.b.2.i. to clarify reporting requirements for Supplied Air jobs	Pearl Lee	Sharon Callahan	4/13/2017
Modified Figure 1 for clarity	Pearl Lee	Sharon Callahan	10/23/2017
- Addition of requirements outlined in MPC RSP 1700 - MPC standards and guidelines added as reference - Hard hat allowance and specified breathing zone distance - Changed frequency of document review from 3yr to annually - Removal of monitor exemptions at loading racks and lab - Specified alarm calibration frequency - Changes to alarm reporting and medical follow up requirements - OSHA Maximum Peak alarm requirements - Update to Alarm Flow Chart - Update to H2S Alarm Notification Report	Pearl Lee	Sharon Callahan	2/4/2019
Corrected the following: • Corrected Breathing zone definition • Removed Andeavor reference in 5.2.c • Removed Watson Cogeneration from monitor exemption under 5.2.d.6 • Corrected monitor placement distance under 5.2.2.1 • Corrected Table no. under 5.4.a and deleted 5.4.b since it is covered in 5.4.a.	Sharon Callahan	Sharon Callahan	9/23/19

Summary of Changes	Changes Completed by:	Approved by:	Date
Added the following: • Added wording for the availability of an amplifier attachment to increase audible alarm level to section 5.2.1 Monitor Requirements. • Added wording to ensure visual alarm can be seen when working in a high noise area to section 5.2.2 Monitor placement.	Sharon Callahan	Sharon Callahan/P &P	2/5/20
Revised the following: • Removed unnecessary definitions for respiratory protection from Table 1. • Added the approved use of Full-Face Air Purifying Respirators (APRs) with the multi gas combination cartridge for escape when top heading coke drums to section 5.4 b and Table 6. • Changed section 5.5 Alarm reporting and Figure 1 to reflect the change from the Share point form to Intelex reporting and deleted Form from procedure. • Added Intelex H2S Alarm Notification Workflow as Section 8. • Removed tasks in Table 6 that are covered under HSS 201 and HSS 306 and added these to Section 2.0 References.	Sharon Callahan	Sharon Callahan/P &P	7//8/20
Revised the following: • Changed section 5.2 d Personal H2S Monitors to clarify meter should be removed and added the minimum barricade distance of 25 feet beyond impacted area. • Added the approved use of Half-Face Air Purifying Respirators (APRs) with the multi gas combination cartridge for escape when sampling molten sulfur from the dome/hatch of the sulfur truck to Table 6.	Sharon Callahan	Sharon Callahan/P &P	1/19/21
Added the approved use of Half-Face Air Purifying Respirators (APRs) with the multi gas combination cartridge for escape when disconnecting hoses from process equipment in H2S service to Table 6	Sharon Callahan	Sharon Callahan	4/8/21
Revised the following: • Clarified Exposure Limits defined in Table 1. • Removed Tesoro Referenced Engineering standards in section 4.7. • Added requirements for Contractors to provide meters capable of retrieving peak reading and adhere to safe work practices to section 4.8. Added requirement to have procedures for maintaining, bump testing/calibrating meters. • Added more examples of engineering control and safe work practices to section 5.1 Safe Work Practices and new section for interim controls. • Changed alarm limits in section 5.2 to reflect current monitor settings. • Changed section 5.4 to Respiratory Protection and added requirements for usage of APRs. • Added air monitoring requirements to section 5.5 Alarm Reporting - H2S release response. • Revised Medical evaluation requirements in section 5.5 Alarm Reporting. • Added table 1a identifying incident investigation level for different alarm levels along with note on investigation level adjustments to section 5.5 Alarm Reporting. • Clarified Training in section 5.6. • Added section 5.7 covering Auditing.	Sharon Callahan	Sharon Callahan/P &P	7/21/21

Summary of Changes	Changes Completed by:	Approved by:	Date
• Added MPC reference and standard recordkeeping language. • Added tasks that have upgraded to APRs to Table 6.			
Revised the following: • Included Table 5 as part of 5.0 Procedure under 5.1.1 Identification of H2S containing process streams. • Added Vapor/Flare Gas Recovery to SDS Name listed in Table 4 and Table 5 .	Sharon Callahan	Sharon Callahan	3/11/22
Clarified the following: • Added Invasive work to Section 5.4 Respiratory Protection Requirements under 5.4 a and c and Table 5.	Sharon Callahan	Mike Kulakowski	3/21/23
Reformatted into MPC format with minor edits	Sharon Callahan	Rinaldo Edmonson	7/20/23
• Revised Medical evaluation requirements in section 3.5 Alarm Reporting 2 (a) for APR usage and Table 1a for Investigation Category above 100 ppm.	Sharon Callahan	Rinaldo Edmonson	4/9/24
Revised the following: • Under Section 2.0 Roles & Responsibilities and 2.8, added adherence to alarm reporting requirements in section 3.5 for Contractor Personnel. • Under Section 3.2 Personal H2S Monitors and 3.2.5 Monitor Maintenance, added requirement to dock monitor after dropping or liquid contact with sensors along with necessary action if any error messages are displayed. • Under Section 3.5 Alarm reporting Table 1A, revised table to reflect no investigation is required for Contractor alarms in the 10 to 19 ppm range.	Sharon Callahan	Rinaldo Edmonson	8/7/24