**Safe Work Requirement**

H2S Safety Procedure

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| PURPOSE The intent of this procedure is to inform all personnel of the hazardous nature of H2S, the safety concerns during drilling and workover operations and the precautionary measures, which are in place for process operations.  The purpose of this procedure is to ensure that risks to people from Hydrogen Sulphide as a result of ECDC operations are controlled and reduced so that the risk to people is as low as reasonably practicable. SCOPE The contents of this procedure are applicable to all ECDC managed sites. Subcontractors working on ECDC managed sites are also responsible for alignment with this procedure.  This document does not replace the procedures prepared and adopted by specialist subcontractors. Neither does it supersede any national regulatory requirements. All guidelines contained shall be regarded as the minimum requirements for all ECDC managed sites.  The scope covers defined activities of all personnel and contractors at any ECDC worksite or workshop.  Where applicable, any variance from this procedure should be authorized by the line Manager. Rig Manager shall be responsible to ensure that rig personnel under their responsibility adhere to all provisions outlined in this procedure. RESPONSIBILITIES      Rig Manager The Rig Manager has overall responsibility for the safety and health of personnel. This includes overall responsibility for ensuring a system is in place to provide the means of visually and audibly warning all personnel working in a sour gas area to evacuate the area, when more than 5 ppm of H2S in the air is detected on the location.  The Rig Manager is responsible for implementing the approved H2S procedure at rig site where work is carried out under their control. Additionally, they shall ensure that any subcontractor working under their direction has attended a site induction and are fully trained in the H2S emergency escape and mustering procedures.  The Rig Manager is responsible and accountable for the application of this procedure in his area of responsibility. He shall ensure:   1. That adequate number of competent responsible persons are appointed to manage and maintain the requirements of this procedure 2. The assessment and management of health risks on the site 3. Review of hazard identification and task risk assessment findings and recommendations 4. Systems are in place to implement and track the actions resulting from the risk assessment 5. Sufficient monitoring systems and equipment is in place and there is adequate equipment available on site, for example, wind sock, gas detectors and breathing apparatus 6. Those mechanisms are in place to communicate the findings, recommendations and requirements of the Hydrogen Sulphide risk assessment to all relevant personnel, including contractors and visitors 7. Ensuring that hazard identification and task risk assessment are carried out before any related tasks are undertaken or begun where H2S may be present 8. Ensuring that all personnel reporting to them are fully informed of the dangers associated with H2S and safety precautions in place to safeguard themselves and the facility 9. Ensuring that they and their respective teams understand the emergency response and mustering procedures to be followed in the event of an emergency 10. Ensuring that their team fully participate in all exercises, drills and safety training 11. Routinely discussing the correct response to an emergency at safety meetings and toolbox talks   (See Appendix 1 - Training, competence and authorization) All personnel at H2S sites All ECDC employees, subcontract personnel and visitors shall be responsible for understanding fully and applying correctly this procedure in the course of their work at sour crude rig site or facility.  ECDC employees, contractors and visitors to the site shall:   1. Complete H2S awareness training, including the use of personal H2S monitors. In addition to the initial training ECDC personnel will have periodic refresher training 2. Obtain a new and/or replacement personal H2S monitor as needed 3. Perform daily self-tests on the personal H2S monitors 4. Wear personal H2S monitors in all process areas and well sites on work wear; in the breathing zone (30 centimetres around the nose and mouth), with the sensor uncovered 5. Immediately leave the vicinity by moving upwind and informing the relevant supervisor/Safety Engineer when the alarm sounds 6. Ensure that their personal issue H2S detector and emergency escape unit is operational and carried with them at all times whilst in an H2S area 7. Wear appropriate PPE as described in the PPE procedure and site-specific procedures; the job risk assessment/job hazard analysis to be conducted on-site prior to the task 8. Demonstrate competency in the selection, use and care of PPE 9. Be responsible for appropriate use, inspection and maintenance of their PPE  HSE Supervisor The HSE Supervisor shall assist the Rig Manager in ensuring all personnel working are trained in the use of personal H2S monitoring and escape sets. They shall also act as the focal point for all H2S training.  The HSE Supervisor shall periodically verify that ECDC employees and contractor personnel are wearing personal H2S monitors and escape sets that meet the specified standards.  The HSE Supervisor is responsible for:   1. Monitoring that protective clothing is being worn as instructed 2. Providing advice on the use of all types of protective clothing and equipment 3. Ensuring that safe working practices are being enforced at all times 4. Issue and maintenance records of personal H2S monitors issued to all personnel 5. Receiving faulty and expired personal H2S monitors and issue of replacements 6. Providing initial training to individuals on the use of the equipment and the actions to be taken in the event of an alarm, prior to the distribution of the units 7. Maintenance, issue, and the management of a loaner pool of personal alarm devices to short term contractors and visitors that are required to enter the plant and well site areas 8. Ensuring that defective equipment is withdrawn from service and repaired   (See Appendix 2 - Compliance and auditing) Task Leader The Task Leader is the person charged with the responsibility of carrying out work at site. He will ensure that all members of the work party are wearing the correct PPE as defined on the Permit. He shall conduct a toolbox talk that includes detailing actions to be taken in the event of an H2S release. Definitions    Hazard Identification and Task Risk Assessment Hazard Identification and Task Risk Assessment (HITRA) is a method of identifying the potential risk in carrying out a specific task which may be low exposure to H2S.  The HITRA will identify the various precautions that will be implemented prior to the start of a task, HITRA and Permit to ensure that the risk is reduced to as low as reasonably practicable. Buddy system A person assigned to assist someone who is working in a hazardous activity such as working in a Hydrogen Sulphide area whose duties include remaining alert to hazards, giving of alarms, keeping rescue lines clear, cross-checking that the correct procedures are being followed and similar activities. The buddy should be protected to the same degree as the person he is assisting. Emergency escapes respiratory protection Breathing apparatus which allows escape from a toxic gas classified area in an emergency, such as a positive pressure, self- contained breathing air type. Personal Hydrogen Sulphide detector Device which must be worn by all personnel entering hydrogen sulphide classified areas, which will alarm if the Hydrogen Sulphide concentration reaches 5 ppm (parts per million). What is Hydrogen Sulphide? Hydrogen Sulphide (H2S) is an extremely toxic gas that is colorless, flammable, heavier than air, soluble in water, and has the smell of rotten eggs at lower concentrations. At higher concentrations H2S can deaden your sense of smell. It is one of our industry's biggest hazards and is responsible for deaths every year. H2S exposure limits Occupational exposure standards for airborne substances hazardous to health are controlled by either Long Term Exposure Limits or Short Term Exposure Limits or both. These are normally expressed as time weighted average concentrations and are calculated in the case of the long term exposure limit, to restrict the total intake of H2S by inhalation over one or more work shifts, and to control the effects due to brief exposure of H2S at higher levels in case of the short term exposure limit. In the case of short term exposure, occupational exposure limits for H2S are defined as follows:   1. **Time weighted average exposure**   The Time Weighted Average is the exposure concentration for a conventional 8 hour workday and 40 hour workweek, to which it is believed that nearly all personnel may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects.   1. **Long term exposure limit**   Long Term Exposure Limit (the 8 hour time weighted average value) for H2S = 5 ppm (7mg/m3).  In case of the standard 12 hour shift, the long term exposure limits for H2S would therefore be 8/12 of 5 ppm = 3.3 ppm.   1. **Short term exposure limit**   The Short Term Exposure Limit is the concentration to which it is believed that personnel can be exposed continuously for a short period of time without suffering from:   1. Irritation 2. Chronic or irreversible tissue damage 3. Dose-rate dependent toxic effects 4. Narcosis of sufficient degree to increase the likelihood of accident, injury, impaired self-rescue, or materially reduced work efficiency   Short Term Exposure Limit (the 15 minute time weighted average value) for H2S = 10 ppm (14mg/m3). The way H2S affects people depends on the level and timescale of exposure and individual susceptibility to the gas (alcohol in the bloodstream enhances the effects of H2S poisoning). It should be noted that the nose is much more sensitive to H2S than detection equipment.  However, it is less proficient at determining the difference between a small amount and an amount large enough to impair the sense of smell; therefore the nose should not be relied on other than as an initial alert to the presence of the gas.  (See Appendix 3 - H2S toxicity table) Pyrophoric scale Carbon steel lines and equipment that carry gas or liquids containing hydrogen sulphide may develop a layer of pyrophoric scale (iron sulphide) on their internal surfaces. When these lines or equipment are opened up to atmosphere, oxygen from the atmosphere will react with the pyrophoric scale to produce spontaneous burning. If hydrocarbons or other combustible substances are present during this reaction, an explosion may result.  **Warning:** A by-product of this oxidising process is Sulphur Dioxide, which is also toxic.  Whenever such lines and equipment are opened up to atmosphere, their internal surfaces should be doused thoroughly with water or blanketed by steam in order that any pyrophoric scale is rendered harmless.  Equipment and pipe work that has been on sour-gas duty (i.e. contains more than 0.5% by weight of H2S) should only be opened in one place at a time unless the pyrophoric scale has been thoroughly wetted. Opening the system in more than one place can cause through drafts capable of igniting the scale. H2S safety    Summary Hydrogen sulphide (H2S) is a colorless gas produced at a number of sour crude oil facilities and wells. It is highly toxic causing fatality after as little as 10 seconds’ exposure to high concentrations.  The potential for exposure to H2S in the drilling and work over operations may exist for employees as a result of either routine or non-routine work tasks involving sour crude oil or gas comes from the well or oil field facilities.  This procedure provides production operations management and supervisory personnel with information needed to protect employees from exposure to the workplace hazards of H2S.  All ECDC personnel and sub-contractors involved in working in an H2S environment must work in compliance with this procedure. Nature and effects of H2S **Warning**: Hydrogen Sulphide (H2S) is a highly toxic gas, even in small doses.  It is colourless and at low concentrations has a strong odour that is often described as that of rotten eggs. Low concentration of H2S hinders the ability of an individual to think clearly by affecting the nervous system.  Soluble in both water (4 volume gas in 1 volume water at 0°C) and liquid hydrocarbons, H2S is flammable and will form an explosive mixture with a concentration between 4.3% and 46% by volume. Auto-ignition occurs at 260ºC, which is a very low ignition point when compared to other gases (Table 1).  Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\2CD599AOOUF)7PUL4E5J$HX.png  **Table 1: Gas explosive limits**  H2S burns with a blue flame and produces Sulphur Dioxide (SO2), less toxic than H2S but very irritating to eyes and lungs and may cause serious injury.  H2S in combination with water forms a weak acid that will attack metals in the same manner as carbon dioxide or oxygen (corrosive to all electro-chemical series metals). H2S embrittles some steels and other materials. This phenomenon is also known as stress corrosion, Sulphide embrittlement and Hydrogen embrittlement.  H2S is heavier than air with a specific gravity 1.189, boiling point: -60.3°C, melting point: -82.9°C. Presence of H2S Hydrogen Sulphide is denser than air and will accumulate in low-lying areas such as tanks, cellar, vaults and excavations. It is still toxic and can explode many days after the gas has escaped if undisturbed. Vapours may travel a considerable distance, and flash back if they reach a source of ignition.  H2S can also be swept along with the produced gas and be present on high spots.  **Warning:** One part per million (ppm) would be one teaspoonful in approximately 25 drums (Figure 1).  Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\73XRQ8APTG%UCV8Y_8PI)}Y.png  **Figure 1: One part per million (ppm)** H2S hazards and symptoms Extremely toxic (almost as toxic as Hydrogen Cyanide) and 5 to 6 times as toxic as Carbon Monoxide, H2S can be only smelt at low concentrations (1-50 ppm). Beyond 50 ppm, the sense of smell is lost after about 15 minute exposures.  (See Appendix 3 - H2S toxicity table)  **Warning:** Do not depend on smell to detect H2S.  H2S is irritating, asphyxiating and very poisonous. It irritates the eyes and throat at low concentrations (30- 150 ppm). At 500 ppm it causes dizziness and unconsciousness within 20 minutes.  Concentrations of 1,000 ppm of H2S cause immediate unconsciousness, and death quickly follows unless artificial respiration and/or oxygen treatment is promptly applied. Refer to Appendix 3 - H2S toxicity table. Death may occur even if the individual is removed to fresh air at once.  H2S poisoning is not cumulative like mercury, lead or radioactivity. Repeated short exposures will not have same effect as one lengthy exposure. Treatment Immediately remove the victim from the hazardous area to fresh air while wearing self-contained breathing apparatus and using the buddy system usually by moving in the up wind direction. （For example, 2 people, 1 rescuing, 1 in standby in safe area).  Immediately summon medical help and treat for shock.  Treatment of life threatening H2S poisoning, characterized by loss of consciousness and associated respiratory failure, is aimed at:-   1. Maintaining respiration by supportive measures. Oxygen resuscitator must be used as soon as possible 2. Treatments of local irritant effects of H2S gas on the eyes and mucous membranes of respiratory tract by supportive measures and medical treatment 3. Enhancing detoxification by administration of antidotes  H2S procedure and control    Classification of H2S areas  1. **High risk areas**   High risk areas are those areas where Hydrogen Sulphide is likely to be continually present above the 8 hour Time Weighted Average Long Term Exposure Limit of 5 ppm (see Appendix 3) for long periods during normal operations and where routine monitoring is mandatory.  In rig site where H2S is likely to be encountered, sufficient self-contained (positive pressure) breathing apparatus sets (working sets) shall be kept for all persons normally working in that area. Two full spare air cylinders for each set shall be held in reserve in an open-air safe area. Adequate numbers of 10 minute duration escape sets shall also be provided.  If the presence of H2S in the air is suspected or an alarm is activated, personnel must leave the area immediately, if possible heading first 90 degrees to the current wind direction then head upwind to a safe must point/area.    Entry into such areas where the presence of H2S is known shall be permitted only under a planned entry procedure and a work permit. Personnel, working in pairs, must wear self-contained positive pressure breathing apparatus or an airline. A standby rescue team must be in attendance.  Installation of wind direction indicators (windsocks or flags) in high-risk areas, to aid direction of escape upwind/across wind is required.   1. **Medium risk areas**   Medium risk areas are those areas where Hydrogen Sulphide may occur during certain planned operations and maintenance activities and where monitoring is carried out during these operations.  Only authorized persons should enter these areas. Work shall be carried out under Permit procedures that must list precautions to be taken. The area should be monitored with portable Hydrogen Sulphide detection equipment during these activities. In both the above cases, it is vital that the source of any H2S is clearly identified and an assessment made of any potential for deterioration.   1. **Low risk areas**   Low risk areas are those areas where Hydrogen Sulphide is not likely to occur during normal operations, and if it does occur it will exist only for a short time for example, system malfunctions. Personnel entering low risk areas must be made aware of the possibility of the presence of Hydrogen Sulphide and the emergency arrangements in force at the site. Access control to H2S areas Entry to any H2S area must be controlled and the area must be secure (Figure 2). Access to H2S areas shall be limited to personnel authorized by the Rig Manager and holding a valid certificate for Hydrogen Sulphide competency as detailed in Appendix 1.  A system must be in place for personnel to register in/out when entering or leaving H2S areas so that it is possible to establish who is present in the event of an emergency. Personnel entering H2S areas must have a personal portable hydrogen sulphide detector which will alert them if the Hydrogen Sulphide level rises to the toxic gas warning level, and that the emergency escape mask shall be donned immediately on alarm.  Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\)G0B2DEKX2)6KP]0U6AF]CV.png  **Figure 2: Potential H2S present warning access sign** Permit Work in H2S areas All facilities where a Hydrogen Sulphide hazard exists must follow the Permit to Work system. Permits in H2S areas must not be used without pre-work site inspection, which must include as a minimum:   1. Determination of potential for release 2. A HITRA 3. Correct isolation 4. Appropriate controls/PPE 5. Personal H2S detector (Figure 3) 6. Buddy system 7. Requirements for continuing detection 8. Special consideration when breaking containment   All lockouts, interlock removal, including the movement of locked valves and similar operations undertaken in H2S areas must be controlled by Permit and verified using the buddy system.  **Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\X{]75U6171X(03]$`YWL}RK.png**  **Figure 3: MSA altair personal single gas H2S detector** Controlled work in H2S areas Positive pressure self-contained breathing apparatus must be used for all operations where there is a risk that personnel may be exposed to Hydrogen Sulphide concentrations above 5 ppm as a result of equipment failure or human error during the operation. This includes all of the following operations whenever such a Hydrogen Sulphide risk could exist:   1. Breaking of containment, including swinging spectacles or inserting spades 2. Taking samples, including product quality activities where the possibility of dangerous levels of hydrogen sulphide exist 3. Confined space entry 4. Local venting of equipment, including instruments during calibration or testing, where personnel are so close to the vent that they could be exposed to concentrations above the short term exposure limit 5. Correct purging and venting can greatly reduce the risk of exposure to H2S  Survey monitoring in H2S areas Rig Manager must ensure surveys of operations are continually conducted during controlled work in an H2S area. This may be sampling and venting to determine the need for breathing apparatus and any limitations on the time personnel can be present to avoid exceeding the allowable Time Weighted Average dose. These surveys should take into account Hydrogen Sulphide concentration arising from unavoidable emissions during the operation together with background emissions from such sources as leaking valve stems or local venting.  Survey measurements shall be conducted using portable Hydrogen Sulphide monitors for:-   1. Monitoring inside confined spaces for confined space entry 2. Detection of leak sources 3. Monitoring when lines, valves, or vessels are opened to the open atmosphere 4. As part of the work Permit requirements 5. As part of confined space entry Permit requirements   HSE supervisors shall ensure that employees are not exposed to concentrations exceeding 5 ppm. If entry is required into an area that will expose the employee to H2S concentrations above 5 ppm, a self-contained breathing apparatus or air supplied breathing apparatus is required.  Hydrogen Sulphide (H2S) is a highly toxic gas. Prior to all maintenance or fabrication activities on equipment or areas where sour gas is produced, testing for its presence is mandatory. These occasions include:   1. Work inside vessels that have contained sour hydrocarbon products 2. Repair work to piping that has been in sour hydrocarbon service 3. Maintenance work on pump and compressor casings in sour service   On any occasion where the presence of Hydrogen Sulphide is suspected, specific testing must be carried out in addition to testing for the presence of other gases.  If required, tests for H2S should be carried out at all levels. The gas is heavier than air and will tend to concentrate at lower levels. If sour gas is suspected then wearing of full self-contained breathing apparatus is essential. Personal Protective Equipment in H2S areas    PPE - general PPE (Personal Protective Equipment) is an essential component in protecting employees from on-the-job injuries. The ECDC is obligated to provide all personnel with the proper PPE necessary at no cost to protect them from workplace hazards.  As a minimum, all personnel and visitors must wear the following approved PPE when working in operational areas:   1. Hard hats 2. Steel-toed footwear 3. Safety glasses 4. Flame retardant coveralls   The following sections detail the minimum mandatory requirements for additional PPE required when working in a rig site that may encounter H2S. Emergency and rescue respirators For each rig site, an analysis of the potential emergency and rescue uses of respirators must be made to determine the quantity of emergency respirators required and the places requiring them.  Emergency contingency plans for high-risk areas must consider the use of respiratory protection by visitors.  When using self-contained breathing apparatus for emergency purposes, a trained standby person must be present with a backup self-contained breathing apparatus and other appropriate equipment such as a radio and lifeline.    The first action of a standby person in an emergency is to notify others. The next step is to attempt rescue. If an H2S emergency occurs within a confined space, confined space entry rescue must only be attempted by trained personnel with a standby person present. Self-contained breathing apparatus with lifeline(s) attached and other appropriate equipment must be used. Emergency escape respiratory protection Emergency escape respirators are units that will provide a high degree of protection for a short period of time (circa 10± minutes) to allow for escape from a highly hazardous environment or the incident scene. The selection of the best type of respirator for escape from contaminated atmosphere will depend on the nature of the hazard and the ability of the employee to leave the contaminated area. Escape respirators should not be used for normal operations which require the use of breathing apparatus.  There is one type of positive pressure respirator available for emergency escape purposes:-  **Emergency escape set with full face mask**  The emergency escape set with full face mask is a small self-contained breathing apparatus unit consisting of either a compressed air cylinder contained in a jacket pouch or fitted with a shoulder strap, feeding compressed air via a regulator valve to a face mask. As with the larger self-contained breathing apparatus units, the escape sets are designed with a positive-pressure supply to the mask (Figure 4).  Air-supplied escape sets are recommended. However, chemical cartridge respirators may be considered, on a limited and carefully selected basis, for emergency escape purposes. For example, they should only be considered if the foreseeable toxic gas content of the atmosphere is below the threshold level. There must be a regular maintenance program to ensure the integrity of the masks and a training programed to ensure proper use of the respirators.  For the emergency escape set the approved standards are: EN 137 - 2006 or equivalent standards.  The emergency escape set shall be replaced in the following cases:-   1. When the face piece rubber shows signs of wear or damage, thus reducing the ability to achieve a good seal 2. When the straps are damaged or broken 3. When the air hose and fittings show signs of damage   Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\AWC1W06WXU6IQ8T@9){77UC.png  **Figure 4: Emergency escape set** Self-contained breathing apparatus Self-contained breathing apparatus is used when there is a likelihood of toxic gas, oxygen depletion or smoke occurrence in the operations which requires that personnel are provided with suitable equipment to protect their respiratory systems (Figure 5).  The demand valve type self-contained breathing apparatus is supplied with air from a cylinder and exhausts to the atmosphere. There is no recirculation of air. The high-pressure compressed air cylinder is normally carried on the back. However, the cylinders used with the smaller escape sets can be carried at the waist or over the shoulder. The design airflow is 350-400 litres per minute and the air supply is regulated by two different modes:-   1. Demand: air supplied via 2-stage regulator with reduced pressure from. The admission valve is activated upon inhalation 2. Pressure-demand: similar to demand type except that there is a special exhalation valve which maintains a positive pressure in the face mask at all times. The regulator supplies additional air on demand. It is recommended that only pressure-demand types which maintain a positive pressure in the mask even at peak air demand are used.   All self-contained breathing apparatus must have a warning device to indicate when only 20-25% of service time remains. Only a full face mask type should be used in hazardous atmospheres.  Self-contained breathing apparatus shall be replaced in the following cases:   1. the face piece should be replaced when the rubber shows signs of wear or damage, thus reducing the ability to achieve a good seal 2. When the straps are damaged or broken 3. The air hose and fittings should be checked every time before the equipment is used to assure the user that the hose and fittings are not damaged   Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\6@Q1)NC7UO5MAYH$}UB8EL2.png  **Figure 5: Self-contained breathing apparatus** Constant flow airline breathing apparatus Supplied compressed air-line respirators should be of demand and constant flow type. The user is supplied with breathing quality air through a hose connected to a central source (Figure 6). The air source may be a bank of compressed air cylinders supplied from a dedicated breathing air compressor or compressed air cylinders.  The breathing air compressor air inlet shall be located in an area of uncontaminated air and upwind from any potential contaminants. Air-line respirators shall be full face mask, hood or helmet or a complete suit. They are available in demand, pressure-demand and continuous flow configurations.  The demand and pressure-demand operate in the same manner as described under self-contained breathing apparatus. The continuous flow type maintains an air flow at all times.  The air-line respirators shall be replaced in the following cases:-   1. The face piece should be replaced when the rubber shows signs of wear or damage, thus reducing the ability to achieve a good seal 2. When the straps are damaged or broken 3. The air hose and fittings should be checked every time before the equipment is used to assure the user that the hose and fittings are is not damaged   Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\[EP6VHFHA4NP~@640C@I)HJ.png  **Figure 6: Airline breathing apparatus** H2S emergency response    H2S contingency planning It is not feasible to provide a single plan for every contingency at every site. Plans must be prepared on a site by site basis, and should cover:-   1. Planning for a Hydrogen Sulphide release 2. Personnel training 3. Hydrogen Sulphide monitoring   In addition, sites that have a Hydrogen Sulphide risk must have an alarm system that is understood by all personnel.  A site action plan should be prepared showing the location of safe areas according to prevailing wind conditions. A wind sock showing wind direction should be prominently located at each site where H2S may be encountered so that personnel can select the upwind direction.  Three safe areas will be defined for sites:   1. Two areas will be in the open air on opposite sides of the site (so that at least one will be up wind of any incident). These areas shall be used for mustering essential personnel 2. The third area (at a remote off-site location) will be used to muster all non-essential personnel   Protective/emergency equipment should be stored or located near to the two safe areas used for essential personnel. In addition, in areas where H2S is likely to be encountered, sufficient self-contained positive pressure breathing apparatus sets shall be kept for persons normally working in that area. Two full spare air cylinders for each set shall be held in reserve in an open-air safe area. Adequate numbers of escape sets shall also be provided.    Where operations are being carried out in a known Hydrogen Sulphide area, and where personnel may be required to wear breathing apparatus, it should be ascertained that personnel have no obvious medical conditions that might endanger their health or performance prior to breathing apparatus training. H2S alarm activation If an H2S alarm sounds, employees shall move quickly and cautiously to a location upwind and away from potential H2S sources.  **Note:** This may require employees to initially move perpendicular to the wind, in order to safely avoid the H2S source.  The site-specific emergency response plan provides an organized immediate action plan for alerting and protecting personnel in the event of a major H2S release. The emergency response plan contains information on, but not limited to, the following subjects:   1. Emergency procedures 2. Responsibilities of employees 3. Immediate action plan 4. Telephone numbers and communication methods 5. Evacuation routes and musters locations 6. Safety equipment and supplies available; for example, number and location of breathing equipment 7. Characteristics of Hydrogen Sulphide   If the presence of H2S in the air is suspected, personnel must leave the area immediately.  The rig manager, following risk assessment, accompanied by an Authorized Gas Tester shall don breathing apparatus and investigate, by using suitable test equipment, the concentrations of H2S in the air.  Upon recognition of an H2S gas hazard, for example by smell, or on activation of personnel H2S detectors, as a minimum, the following steps should be incorporated into any response to a H2S release:-   1. Evacuate the area, moving upwind/across wind if possible 2. If necessary, don an emergency breathing apparatus escape set to effect safe escape 3. Do not attempt to rescue other personnel from the H2S area unless equipped with a full duration breathing apparatus set but it is preferred to leave it to the rescue team 4. A person outside the H2S risk area should oversee personnel working in an H2S atmosphere or on equipment where H2S is present   On discovery of an H2S leak or finding a victim of H2S exposure, any accidents/incidents shall be reported in accordance with ECDC Incident Management Procedure.  Shift supervisors shall ensure that no employee re-enters the area without respiratory protection until the source of H2S has been identified, and the area has been re-monitored and declared safe for entry.  Shift Supervisors shall ensure that at least one standby employee is present prior to entry. The standby employee shall:-   1. Be knowledgeable about H2S safety and rescue 2. Wear a self-contained breathing apparatus in the standby mode 3. Have access to a radio to summon help in case of an emergency 4. Wear a personal H2S detector unit  H2S and fire Shift supervisors shall take special precautions with pressure fires involving H2S gas streams. It is important to eliminate the fuel source before extinguishing the fire to prevent an H2S cloud from forming.  Extinguishing agents recommended to fight Hydrogen Sulphide fires include carbon dioxide, chemical dry powder and water sprays.  When ignited, H2S burns with a pale blue flame and produces sulphur dioxide (SO2) gas. When sulphur dioxide contacts moisture, it forms sulphuric acid, a corrosive substance. Therefore, low concentrations of SO2 are capable of causing irritatation / injury to the eyes and respiratory system. SO2 is heavier than air and inhalation at certain concentrations can lead to injury or death. Therefore, fire-fighters shall wear self-contained breathing apparatus units when fighting H2S fires. H2S gas indicators    H2S gas indicators - remote and fixed Remote fixed and personal H2S gas meters should be set to alarm at 5 ppm.  Indicators on these instruments consist of meters, audible alarms, lights, or a combination of all three. The meter readouts are calibrated in total percentage of gases or vapour in the atmosphere. It is important that you know specifically the information provided by the instrument you are using.   1. Each manufacturer furnishes a set of operational instructions for the particular instrument. In all cases, operating procedures as determined by the manufacturer must be followed by the user 2. Both manual and continuous H2S indicators are available in portable models. With either unit, the operator should check the batteries before use   H2S gas indicators are available which can be installed on a fixed or permanent type basis where needed. Tube type H2S indicators **Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\BXC`@_C$6]LW5K9P470QZ_3.png**  **Figure 7: Tube type indicator**  These types of indicators are simple to operate. They work by depressing a spring-loaded bellows, which pulls a calibrated quantity of air through a glass tube. Inside the glass tube is a chemical that reacts to specific toxins by changing colors. When a sample is taken from the atmosphere, the concentration of the chemical in the atmosphere is measured by comparing the color change on the tube to a scale printed on the outside of the tube (Figure 7). Personal H2S monitors Personal H2S monitors function by electronically measuring a reaction within a “cell” which is filled with a chemical that reacts with H2S. When the reaction reaches a set point, an audible alarm sounds to warn the user to leave the area.  Personnel using electronic monitors must be trained how to operate the monitor and must follow the manufacturer’s instructions. The monitor must be calibrated (according to manufacturer’s recommendations), have good batteries or a good charge, and be well maintained. Sensing cells should be replaced according to the manufacturer's recommendations or sooner if exposed to high concentrations of H2S. Electronic monitors tend to lose calibration very quickly especially when exposed to drastic temperature changes or high H2S concentrations.  Limitations of personal H2S monitors: -   1. Give the user a false sense of security 2. Loose calibration easily 3. Only detect H2S 4. Require regular battery maintenance 5. Require regular calibrations  Inspection, calibration and maintenance H2S gas detectors require inspection, maintenance, and calibration.  Records of inspection, calibration, and maintenance should be maintained on each detector to ensure that checks for operational readiness are performed according to the manufacturer specifications. The designated representative's initials and the date inspected should be recorded.   1. Safety department will maintain a master record of issue 2. Departments are responsible for control and use in their areas of responsibility 3. Relevant Safety Advisers will support in the training in the use of detector 4. Contingency stock will be held at degassing stations   10．**Record**  10.1 BSA-ECDC-HS-CL-S009-01-Gas Monitoring System Check Record v1.0  10.2 BSA-ECDC-HS-CL-S009-02-Portable Gas Detector Check v1.0  10.3 BSA-ECDC-HS-CL-S009-03-SCBA Weekly Check v1.0 Appendix 1 - Training, competence and authorisation Personnel who are required to work or visit a rig site shall be instructed as to the hazard of H2S and the available personal safety equipment, H2S detectors, alarms, ventilation procedures, briefing areas and emergency response procedures.  Training will take place at safety inductions and will include the following:-   1. Induction and briefing of all new facility arrivals on the dangers of H2S and the correct procedures to follow 2. The use of personal H2S detectors and escape sets 3. The use and calibration of all gas monitoring equipment 4. Recognition of alarms and action to be taken 5. Muster at safe briefing areas 6. The ‘buddy system’ 7. Explanation of the contingency plan   Information relating to safety measures in the event of a H2S emergency will be posted around the facility.  After training, the attendees should have:-   1. The ability to demonstrate understanding of the course topics 2. The ability to use personal H2S detectors and escape sets based on the potential hazards and risks involved 3. Knowledge of alarms and action to be taken in the event of alarm activation 4. A Hydrogen Sulphide competency certificate   Hydrogen Sulphide competency certificates will be valid for 12 months, after which refresher training is required.  **Training of emergency response teams**  Personnel in teams who will be responding to Hydrogen Sulphide emergencies must be trained in:-   1. Methods of rescuing personnel overcome by hydrogen sulphide 2. The use of equipment they may be using for emergency response 3. How to make the area safe, for example, performing isolations 4. Means of communication 5. Treatment for personnel exposed to hydrogen sulphide   Personnel must be able to demonstrate their competency in these subjects in a practical test before being allowed to take up their duties in an emergency response team. Appendix 2 - Compliance and auditing The ECDC shall periodically review H2S related activities, including review of H2S training and review of overall procedure. Such reviews may also include:   1. General compliance with this document and any local procedures 2. Registers of competent and authorized persons   If an incident occurs the H2S documentation must be kept with the incident investigation report.  **Monitoring**  H2S designated areas shall be monitored. A variety of equipment and techniques can be used to do so:-   1. Supervisors shall require that personnel use continuous monitoring devices with audible and/or visual alarms, when they perform tasks involving potential exposure to hydrogen sulphide 2. Supervisors shall ensure that representative employees are selected to wear personal monitors or carry a portable gas detector if available when a group of employees are working close together 3. Supervisors shall make sure that monitors are utilized for the complete duration of work shift, and that they are set to alarm at 5 ppm or less   Daily: Routine day-to-day checking by the worksite supervisor to ensure H2S monitoring equipment is inspected and calibrated as required by the manufacturer.  Routine surveys (recommended bi-annually) of process flow streams and storage areas should be carried out to monitor the level of H2S present in facility equipment. These surveys should be completed using the correct sampling techniques and equipment. By accurately monitoring the H2S levels in process streams, trends in H2S levels can be monitored over time.  **Auditing**  Annually: Safety and operation departments shall periodically audit the H2S procedure to assess how it has been used over a period (once a year) and to ensure it is being operated as intended.  These assessments will be used to provide feedback to management of non-compliance and provide management with a level of assurance that work activities are being controlled safely. Records are maintained by safety department. Appendix 3 - H2S toxicity table **H2S toxicity table**  Description: C:\Users\USER\AppData\Roaming\Tencent\Users\1045450198\QQ\WinTemp\RichOle\CZHQB~CLP@2QGRLL}(4)N$B.png |