

ENERGEN

R E S O U R C E S

H2S CONTINGENCY PLAN

REVISED November 6, 2013

ENERGEN RESOURCES CORPORATION
Hydrogen Sulfide Contingency Plan
For Drilling/Workover/Facility

1) INTRODUCTION

H₂S is a toxic, poisonous gas that could cause death or injury. The objective of this contingency plan is to provide an organized plan of action for alerting and protecting the public from H₂S exposure in the event a potentially hazardous volume is accidentally released to the atmosphere. This plan should be activated immediately if any such release occurs. The Contractor Drilling Rig Designated Person (CDRDP) is responsible for initiating and carrying out the plan.

2) INDIVIDUAL RESPONSIBILITIES

It is the responsibility of all personnel on the location to familiarize themselves with the procedures outlined in this contingency plan.

- a) All personnel:
 - i) Responsible for his assigned safety equipment.
 - ii) Responsible for familiarizing himself with the location of all safety equipment.
 - iii) Responsible for reporting any indications of H₂S to those in the area and to a supervisor.
- b) Contractor Drilling Rig Designated Person (CDRDP)
 - i) Responsible for thoroughly understanding and seeing that all aspects of this contingency plan are enforced.
 - ii) Responsible for initiation of this contingency plan.
 - iii) Responsible for keeping a minimum of personnel on the location during expected hazardous operations
 - iv) Responsible for coordinating all well site operations and communications in the event that an emergency condition develops.
 - v) Responsible for ensuring that all visitors receive an H₂S Safety orientation. A visitors log will be maintained as well as a list of all personnel on the location after drilling has progressed to the suspected H₂S formation.

3) LOCATION AND LAYOUT

- a) The location of at least two pre-determined safe areas to assemble in the event of an emergency. These locations should be located 180 degrees to one another, and in the direction of the prevailing winds.
- b) H₂S rig monitor: The stationary detector with three sensors will be placed in the upper dog house if equipped, set to visually alarm @ 10 ppm and audible at 14 ppm. Calibrate a minimum of every 30 days or as needed. The sensors will be placed in the following places: (Gas sample tubes will be stored in the safety trailer)

- Rig Floor

- Bell Nipple
- End of flow line or where well bore fluid are being discharged.
- c) The location of windsocks or streamers as illustrated in the attached drawing.
- d) WARNING SIGNS
 - i) "NO SMOKING" signs should be strategically located around the rig and rig location. The following locations are appropriate:
 - (1) Doghouse
 - (2) Rig Floor
 - (3) Substructure
 - (4) Lower Landing of all stairs leading to rig floor
 - (5) Mud pits
 - (6) Shale shaker
 - ii) "POISON GAS" signs should also be strategically located around the rig and rig location. The following locations are appropriate:
 - (1) All entrances leading to the location
 - (2) Lower landing of all stairs leading to the rig floor
 - (3) All areas around substructure, including mud pits and shale shaker
 - (4) Various points along the perimeter of the radius of exposure
 - (a) NOTE: All warning signs should be black and yellow in color and of readable size at a reasonable distance.

4) **OPERATING PROCEDURES** The following operating procedures will be utilized for drilling in areas with H2S.

- a) Plan of operating for handling gas kicks and other drilling problems. Any gas kick will be controlled by using approved well control techniques. Upon evidence that ambient H2S concentrations have reached 10 PPM, all non-essential personnel will be evacuated to pre-determined safe areas. Personnel remaining on the rig floor will continue to control the well until the situation indicates the area is safe to re-enter. This will be accomplished by flowing the gas through a 'gas buster/separator' via the choke manifold. From the gas buster the gas will flow to the flare for ignition.
- b) Special Operations
 - 1. Drill Stem Tests. All drill stem tests must be closed chamber and conducted during daylight hours.
 - 2. Coring. After a core has been cut, circulate bottoms up and monitor for H2S. If hole conditions (and/or detectors) indicate potentially hazardous conditions, put breathing equipment on 10 stands before core barrel reaches the surface. Breathing equipment will be worn by all personnel while core barrel is pulled, broken out and opened up, and until a safe atmosphere is indicated.

- 5) **OPERATING CONDITIONS** Operating conditions are defined in three categories. A description of each of these conditions and the required action to take are given below.

a) **CONDITION I - Normal Operating Conditions, Potential Danger, Operations Under Control**

Characterized by: Normal drilling operations and test operations in zones which contain or may contain H₂S.

Warning Flag: Yellow

Alarm: None

Probable Occurrence: No detectable gas present at surface.

General Action:

- i. Know location of safety equipment
- ii. Check safety equipment for proper function. Keep it available.
- iii. Be alert for a condition change.

b) **CONDITION II - Potential to Moderate Danger to Life**

Characterized by: H₂S gas present. Concentration less than 10 PPM.

Warning Flag: Orange

Alarm: Flashing light at 10 PPM H₂S.
Intermittent blasts on horn at 10 PPM H₂S.

Probable Occurrence:

- i. As drill gas.
- ii. As trip gas when circulating bottoms up.
- iii. When a core barrel is pulled.
- iv. When a well kick is circulated out.
- v. Surface pressure, well flow or lost operations.
- vi. Equipment failure during testing operations.

General Action:

- i. Follow instructions of supervisor.
- ii. Put on breathing equipment if directed, or conditions warrant it.
- iii. Stay in "SAFE BRIEFING AREA" if instructed and not working to correct the problem.
- iv. Necessary operations will be conducted with absolute minimum personnel.
- v. If gas containing hydrogen sulfide is ignited, the burning hydrogen sulfide will be converted to sulfur dioxide, which is poisonous.

c) **CONDITION III-Moderate to Extreme Danger to Life**

Characterized by: H₂S present in concentrations at or above 10 PPM. Critical well operations or well control problems or in the extreme, loss of well control.

Warning Flag: Red

Alarm: Flashing light and continuous blast on horn at 10PPM H₂S.

Probable Occurrence:

- i. As drill gas.
- ii. As trip gas when circulating bottoms up.
- iii. When a core barrel is pulled.
- iv. When a well kick is circulated out.
- v. Surface pressure, well flow or lost return problems
- vi. Equipment failure during testing operations.

General Actions:

- i. Put on breathing equipment. Move to "SAFE BRIEFING AREA" and remain there if not working to correct the problem.
- ii. Follow instructions of CDRDP or other supervisor.
- iii. The CDRDP will initiate emergency action as provided in the contingency plan and as appropriate to the actual conditions. If testing operations are in progress the well will be shut in.
- iv. The CDRDP will conduct any necessary operations with an absolute minimum of personnel. All persons in the immediate area will wear a breathing apparatus. All other personnel will restrict their movements to those directed by the superintendent.
- v. If gas containing hydrogen sulfide is ignited, the burning hydrogen sulfide will be converted to sulfur dioxide, which is poisonous.

- 7) **EMERGENCY PROCEDURES** The procedures listed below apply to drilling and testing operations. If at any time during Condition I, the Mud Logger, Mud Engineer, or any other person detects H₂S, he will notify the CDRDP. All personnel should keep alert to the CDRDP's orders.

He will:

- i) Immediately begin to ascertain the cause or the source of the H₂S and take steps to reduce the H₂S concentration to zero. This should include having the mud engineer run a sulfide and pH determination on the flow line mud if water-base mud is in use. If an oil-base mud is in use, the Mud Engineer should check the lime content of the mud.
- ii) Order non-essential personnel out of the potential danger area.

- iii) Order all personnel to check their safety equipment to see that it is working properly and in the proper location. Persons without breathing equipment will not be allowed to work in a hazard area.
 - iv) Notify the contract Supervisor of the condition and action taken.
 - v) Increase gas monitoring activities with portable H₂S detectors and continue operations with caution.
 - vi) Display the orange warning flag.
- b) If the H₂S concentration exceeds 10 PPM the following steps WILL be taken:
 - i) Put on breathing equipment
 - ii) Display red flag.
 - iii) Driller-prepare to shut the well in.
 - (1) Pick up pipe and get Kelly out of BOP's
 - (2) Close BOP's if necessary.
 - iv) If testing operations are in progress, the well will be shut-in.
 - v) Help anyone who may be affected by gas.
 - vi) Evacuate quickly to the "SAFE BRIEFING AREA" if instructed or conditions warrant.
- c) In the event a potentially hazardous volume of H₂S is released into the atmosphere, the following steps must be taken to alert the public:
 - i) Remove all rig personnel from the danger area and assembler at a pre-determined safe area, preferably upwind from the well site.
 - ii) Alert the drilling office, public safety personnel, regulatory agencies, and the general public of the existence and location of an H₂S release. See List of Emergency Telephone Numbers.
 - iii) Assign personnel to block any public road (and access road to location) at the boundary of the area of exposure. Any unauthorized people within the area should be informed that an emergency exists and be ordered to leave immediately.
 - iv) Request assistance from public safety personnel to control traffic and/or evacuate people from the threatened area.

8) PROTECTION OF THE GENERAL PUBLIC (ROE)

- a) 100 ppm at any public area (any place not associated with this site)
- b) 500 ppm at any public road (any road with the general public may travel)
- c) 100 ppm radius of ¼ mile in New Mexico will be assumed if there is insufficient data to do the calculations, and there is a reasonable expectation that H₂S could be present in concentrations greater than 100 ppm in the gas mixture

PUBLIC EVACUATION PLAN: Notification of the emergency response agencies of the hazardous condition and implement evacuation procedures.

A trained person in H₂S safety shall monitor with detection equipment the H₂S concentration, wind and area exposure (ROE). This person will determine the outer perimeter of the hazardous area. The extent of the evacuation area will be determined from the data being collected. Monitoring shall continue until the situation has been resolved. (All monitoring equipment shall be UL approved, for use in class groups A, B, C & D, Division 1, hazardous locations. All monitor will have a minimum capability of measuring H₂S, oxygen and flammable values.)

- 1) Law enforcement shall be notified to set up necessary barriers and maintain such for the duration of the situation as well as aid in the evacuation procedure.
 - 2) The company supervising personnel shall stay in communication with all agencies throughout the duration of the situation and inform such agencies when the situation has been contained and the affected area(s) is safe to enter.
- 9) **TRAINING PROGRAM** All personnel associated with the drilling operations will receive training to ensure efficient and correct action in all situations. This training will be in the general areas of: (1) personnel safety, (2) rig operations, and (3) well control procedures.
- a) Personnel Safety Training-All personnel shall have received H2S training in the following areas:
 - i) Hazards and characteristics of H2S
 - ii) Effect on metal components of the system
 - iii) Safety precautions
 - iv) Operation of safety equipment and life support systems
 - v) Corrective action and shutdown procedures
 - b) Rig Operations-All rig personnel shall have received training in the following areas:
 - i) Well control procedures
 - ii) Layout and operations of the well control equipment.
 - c) Service Company Personnel-All service personnel shall have been trained by their employers in the hazards and characteristics of H2S and the operation of safety equipment and life support systems.
 - d) Visitors-all first time visitors to the location will be required to attend a safety orientation. The CDRDP shall be responsible for this orientation and he shall see that every visitor is logged in correctly.
 - e) Public-the public within the area of exposure shall be give an advance briefing by the CDRDP.
 - i) Hazards and characteristics of hydrogen sulfide. It is an extremely dangerous gas. It is normally detectable by its "rotten egg" odor, but odor is not a reliable means of detection because the sense of smell may be dulled or lost due to intake of the gas. It is colorless, transparent, and flammable. It is heavier than air and may accumulate in low places.
 - ii) The necessity of an emergency action plan. Due to the danger of persons exposed to hydrogen sulfide and the need for expeditious action should an emergency occur, this action plan well be put into effect if and when a leak occurs.
 - iii) The location of hydrogen sulfide within the area of exposure at the drilling location.
 - iv) The manner in which the public will be notified of an emergency is by telephone or in person.
 - v) Steps to be taken in case of an emergency:
 - (1) Abandon danger area.
 - (2) Notify necessary agencies and request assistance for controlling traffic and evacuating people.
- 10) **USING SELF CONTAINED BREATHING AIR EQUIPMENT (SCBA):**
1. (SCBA) SHOULD BE WORN WHEN ANY OF THE FOLLOWING ARE PERFORMED:
 - a) Working near the top or on the top of a tank

- b) Disconnect any line where H₂S can reasonably be expected
- c) Sampling air in the area to determine if toxic concentration of H₂S can exist.
- d) Working in areas where over 10ppm on H₂S has been detected
- e) At any time there is a doubt as the level of H₂S in the area.

2. All personnel shall be trained the use of SCBA prior to working in a potentially hazardous location.
3. Facial hair and standard eyeglasses are not allowed with SCBA.
4. Contact lenses are never allowed with SCBA.
5. Air quality shall be continuously checked during the entire operation.
6. After each use, the SCBA unit shall be cleaned, disinfected, serviced and inspected.
7. All SCBA shall be inspected monthly.

11) RESCUE AND FIRST AID FOR VICTIMS OF HYDROGEN SULFIDE (H₂S) POISONING:

- DO NOT PANIC
- REMAIN CALM AND THINK
- GET ON THE BREATHING APPARATUS

12) CALCULATIONS FOR THE 100PPM (ROE) "PASQUILL-GIFFORD EQUATION"

$X = [(1.589) (\text{mole fraction}) (Q\text{-volume in STD cu ft})] \text{ to the power } (0.6258)$

CALCULATION FOR THE 500 PPM ROE:

$X = [(.4546) (\text{mole fraction}) (Q - \text{volume in STD cu ft})] \text{ to the power of } (0.6258)$

Example:

If a well/facility has been determined to have 150/500 ppm H₂S in the gas mixture and the well/facility is producing at a gas rate of 100 MCFPD

Then:

150 ppm $X = [(1.589) (.00015) (100,000\text{cf})] \text{ to the power of } (.6258)$
 $X = 7 \text{ ft.}$

500 ppm $X = [(.4546) (.0005) (100,000 \text{ cfd})] \text{ to the power of } (.6258)$
 $X = 3.3 \text{ ft.}$

(These calculations will be forwarded to the appropriate District NMOCD office when Applicable)

13) PROCEDURE FOR IGNITING AN UNCONTROLABLE CONDITION:

1. Human life and/or property are in danger.
2. There is no hope of bringing the situation under control with the prevailing conditions at the site.

14) INSTRUCTION FOR IGNITION:

H₂S Contingency Plan
 Rev. 1

1. Two people are required. They must be equipped with positive pressure, self-contained breathing apparatus and a "D" ring style full body, OSHA approved safety harness. Non-flammable rope will be attached.
2. One of the people will be qualified safety person who will test the atmosphere for H₂S, oxygen and LFL. The other person will be the company supervisor; he is responsible for igniting the well.
3. Ignite up wind from a distance no closer than necessary. Make sure that where you ignite from has the maximum escape avenue available. A 25 mm flare gun shall be used, with a \pm 500 ft. range to ignite the gas.
4. Prior to ignition, make a final check with combustible gases.
5. Following ignition, continue with the emergency actions and procedures as before.

15) REQUIRED EMERGENCY EQUIPMENT:

1. Breathing apparatus:
 - Rescue packs (SCBA) - 1 (one) unit shall be placed at each breathing area, 2(two) shall be stored in the safety trailer.
 - Work/Escape packs - 4 (four) packs shall be stored on the rig floor with sufficient air hose not to restrict work activity.
 - Emergency Escape Packs - 4 (four) packs shall be stored in the doghouse for emergency evacuation.
2. Signage & Flagging:
 - One color code condition sign will be placed at the entrance to the site reflecting the possible conditions at the site.
 - A colored conditioned flag will be on display, reflecting the condition at the site at the time.
3. Briefing Area:
 - Two perpendicular areas will be designated by signs and readily accessible.
4. Wind Socks:
 - Two windsocks will be placed in strategic locations, visible from all angles.
5. H₂S Detectors & Alarms:
6. Auxiliary Rescue Equipment:
 - Stretcher
 - Two OSHA full body harness
 - 100 ft. 5/8 inch OSHA approved rope
 - 1 - 20#class ABC fire extinguisher
 - Communication via cell phones on location and vehicles on location.

16) WELL CONTROL EQUIPMENT:

1. Flare Line(s) and means of ignition, ignition as outlined in section 14
2. Remote Controlled Choke with ability to isolate to mud/gas separator
3. Flare gun/flares, minimum of 150' away from mud/gas separator and located at outer perimeter of wellpad
4. Mud-Gas Separator and Rotating Head with Upper and Lower Kelly Cock Valve

17) MUD PROGRAM:

1. Mud system and additives will have sufficient properties for adverse effects of H₂S. H₂S Scavengers will be used should H₂S zones be encountered while drilling.
2. A mud degassing system will be used if H₂S should be encountered while drilling.

CONTACT INFORMATION

If at this time the supervising person determines the release of H2S cannot be contained to the site location and the general public is in harm's way he will take the necessary steps to protect the workers and the public.

EMERGENCY CALL LIST: (Start and continue until ONE of these people has been contacted)

OFFICE	MOBILE	HOME
Terry Valentine	205-960-3490	205-915-9323
Buddie Livingston	918-633-3490	918-367-9442
Cam Thacker	281-433-9734	281-751-7487

EMERGENCY RESPONSE NUMBERS:

State Police	Eddy County	575-748-9718
State Police	Lea County	575-392-5588
Sheriff	Eddy County	575-746-2701
Sheriff	Lea County	
Emergency Medical Service (Ambulance)	Eddy County	911 or 505-746-2701
	Lea County Eunice	911 or 505-394-3258
Emergency Response	Eddy County SERC	575-476-9620
	Lea County	
Artesia Police		575-746-5001
Artesia Fire Dept.		575-746-5001
Carlsbad Police		575-885-2111
Carlsbad Fire Dept.		575-885-3125

EMERGENCY CALL LIST (CONTINUED)

Loco Hills Police 575-677-2349

H2S Contingency Plan
Rev. 1

Jal Police		575-395-2501
Jal Fire		575-395-2221
Jal Ambulance		575-395-2221
Eunice Police		575-395-0112
Eunice Fire		575-394-3258
Eunice Ambulance		575-394-3258
Hobbs Police		575-397-3365
Hobbs Fire		575-397-9308
NMOCD	District 1 (Lea, Roosevelt, Curry)	575-393-8203
	District 2 (Eddy, Chavez)	575-748-1283
Lea County Information		575-393-8203
Callaway Safety	Eddy/Lea Counties	575-392-2973
BJ Services	Artesia	575-746-3140
	Hobbs	575-392-5556
Wild Well Control	Midland	432-550-6202
	Mobile	432-553-1166