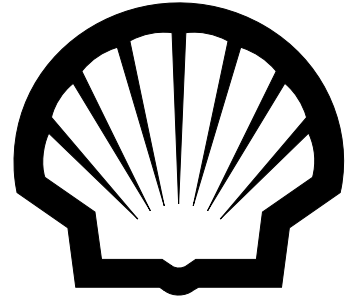


## **Appendix N**

### **H<sub>2</sub>S Contingency Plan for M/V *Noble Discoverer***

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**CHUKCHI SEA REGIONAL**

***HYDROGEN SULFIDE (H<sub>2</sub>S)  
CONTINGENCY PLAN***

**Shell Gulf of Mexico, Inc.**

**Exploration Drilling & Evaluation Operations**

**Rig: *Noble DISCOVERER***

**February 2011**

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## I. DEFINITIONS

- Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE or BOE)-formerly the Minerals Management Service (MMS)
- H<sub>2</sub>S Absent- previous drilling, testing, logging and sampling in the area or in equivalent stratigraphic units have confirmed the absence of H<sub>2</sub>S in the area to be drilled
- H<sub>2</sub>S Present- previous drilling, testing, logging and sampling have confirmed the presence of H<sub>2</sub>S in concentrations and volumes that could potentially result in atmospheric concentrations of 20 ppm or more of H<sub>2</sub>S
- H<sub>2</sub>S Unknown- the designation of a zone or geologic formation where neither the presence nor absence of H<sub>2</sub>S has been confirmed
- Application for Permit to Drill (APD)- forms and supporting information, including a request for a classification of an area with respect to H<sub>2</sub>S (absent, present or unknown), submitted to the BOE in advance of the initiation of drilling operations.
- Request for classification- a letter containing additional data indicating that a different H<sub>2</sub>S classification is required to replace the original classification made by the BOE from data filed with the APD.
- H<sub>2</sub>S Contingency Plan- a set of procedures and practices submitted to the BOE Regional Supervisor Field Operations (RS/FO) prior to the initiation of operations outlining steps to deal with H<sub>2</sub>S hazards in H<sub>2</sub>S Present or H<sub>2</sub>S Unknown classified areas.

## II. INTRODUCTION

This plan was developed because of the potential hazards involved when performing operations in formations that may contain H<sub>2</sub>S. It was written in compliance with the rules and regulations of the BOE in Section 30, Code of Federal Regulations, Part 250, Subpart 490. This plan specifies precautionary measures, safety equipment, emergency procedures, responsibilities, and duties pertaining to drilling operations in potential H<sub>2</sub>S- bearing formations.

There will be one evacuation vessel (to be determined) stationed near the **M/V Noble Discoverer (Discoverer)** at all times. The attending evacuation vessel will be equipped with a breathing air cascade system and an H<sub>2</sub>S detection/alarm system. Specific evacuation procedures are discussed in Section IX, H<sub>2</sub>S Emergency Procedures.

To be effective, this plan requires the cooperation and effort of each individual participating in drilling operations in a well with the potential of releasing H<sub>2</sub>S. Each individual should know his/her responsibilities and duties in regard to normal operations and emergency procedures. Personnel should thoroughly understand and be able to use, at a moment's notice, all safety equipment on board the rig. They should familiarize themselves with the location of all safety equipment and see that their individually assigned equipment is properly stored, easily accessible, and routinely maintained. The ideas and suggestions of each individual involved in the drilling or

abandonment of a potential sour gas well are highly welcomed and are an asset for providing the safest working conditions possible.

This H<sub>2</sub>S Contingency Plan will go into effect upon entering the Chukchi Sea. Safety equipment will be installed on the vessel and will be functional and tested prior to departure from Dutch Harbor. Personnel will be trained and competent to carry out the provisions of the plan.

Shell Gulf of Mexico, Inc. (Shell) intends to make every effort to provide adequate safeguards against harm to persons both on location and in the immediate vicinity from the effects of hydrogen sulfide if released into the atmosphere.

### III. OPERATING PHILOSOPHY

Formations in the Chukchi Sea may or may not contain H<sub>2</sub>S. The BOEMRE, in keeping with the provisions of 30 CFR 250.490, has classified the Chukchi Sea as **H<sub>2</sub>S UNKNOWN**.

Shell is taking every precaution to protect the people and the environment in the unlikely event that H<sub>2</sub>S is encountered. The *Discoverer* will be fitted with all of the equipment and safety devices as required by code and all personnel who will be onboard the vessel during the drilling wells in the Chukchi Sea will be properly trained and drilled as required by code.

### IV. H<sub>2</sub>S and SO<sub>2</sub> Properties

#### A. HYDROGEN SULFIDE

##### 1. Physical Properties

CHEMICAL NAME	Hydrogen Sulfide
CAS NUMBER	7783-06-4
SYNONYMS	Sulfurated hydrogen, hydrosulfuric acid, dihydrogen sulfide
CHEMICAL FAMILY	Inorganic sulfide
CHEMICAL FORMULA	H <sub>2</sub> S
NORMAL PHYSICAL STATE	Colorless gas, vapor density at 59°F (15°C) at 1 atmosphere = 1.1895 SG
IGNITION TEMPERATURE	500°F (260°C)
BOILING POINT	-76°F (-60.2°C)
MELTING POINT	-117.2°F (-82.9°C)
FLAMMABLE LIMITS	4.3 - 46% by volume in air
SOLUBILITY	Soluble in water and oil; solubility decreases as the fluid temperature increases.
COMBUSTIBILITY	Burns with a blue flame to produce sulfur dioxide.
WARNING PROPERTIES	H <sub>2</sub> S has an extremely unpleasant odor, similar to the smell of rotten eggs, and is easily detected at low concentrations

	(0.13 ppm). Due to the paralyzing effect the gas has on the olfactory nerve, <b>THE SENSE OF SMELL IS <u>NOT</u> AN ACCEPTABLE INDICATOR.</b>
--	---

## 2. Exposure Limits

The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for H<sub>2</sub>S is 10 ppm for eight-hour time-weighted average (TWA<sub>8</sub>) or 15 ppm for short term exposure limit (STEL) as averaged over 15 minutes, per 29 CFR Part 1910.1000, "Toxic and Hazardous Substance," U.S. Department of Labor, Occupational Safety and Health Administration. Recently, the American Conference of Governmental Industrial Hygienists (ACGIH) reduced their recommended exposure limits for H<sub>2</sub>S. ACGIH voted to reduce the 8-hour time-weighted average Threshold Limit Value (TLV-TWA<sub>8</sub>) for H<sub>2</sub>S from 10 to 1 ppm and their Short Term Exposure Limit (TLV-STEL) from 15 to 5 ppm. ACGIH TLVs reflect industry consensus on the level of exposure a typical worker can experience without unreasonable risk of disease or injury. These limits are voluntary standards and are not enforceable where OSHA's PELs and regulatory concentration limits are. Most currently available H<sub>2</sub>S measuring and monitoring equipment is not accurate in the 1 ppm range. The National Institute for Safety and Health (NIOSH) considers a concentration of 100 ppm H<sub>2</sub>S to be immediately dangerous to life and health (IDLH). For purposes of this contingency plan, the concentration values listed in 30 CFR 250.490 will be used for detection, alarm and action limits.

## 3. Physiological Effects

When a person inhales H<sub>2</sub>S, the gas goes directly through the lungs and almost instantaneously into the bloodstream. Through an oxidation reaction, H<sub>2</sub>S is broken down in the body into a harmless compound. However, if the individual breathes in large quantities of H<sub>2</sub>S, the oxidation process lags behind the intake rate of the gas. The unoxidized H<sub>2</sub>S builds up in the blood and the individual becomes poisoned. The nerve center in the brain which controls breathing is paralyzed and the respiration process is halted. Death is caused by asphyxiation at the cellular level.

Susceptibility to H<sub>2</sub>S poisoning is dependent on four factors:

- **Duration:**

The length of time the individual is exposed to non-lethal concentrations of H<sub>2</sub>S. Longer exposure to low H<sub>2</sub>S concentrations has a desensitizing effect on the sense of smell.

- Frequency:**  
 How often the individual is exposed to H<sub>2</sub>S. Closely repeated short-term exposures at low concentrations may lead to chronic irritation of the eyes, nose and throat and headaches, dizziness and upset stomach. Even at concentrations under 5 ppm, metabolic changes and increased anxiety have been reported in people who are exercising.
- Intensity:**  
 The concentration of the exposure. The higher the concentration, the greater the physiological effect.
- Individual Susceptibility:**  
 Dependent on the individual's physiological make-up. Studies show that symptoms of H<sub>2</sub>S exposure vary considerably because of individual physiological make-up. Personnel may be highly susceptible to H<sub>2</sub>S due to health reasons such as lung diseases, and the individual's mental state such as anxiety attacks.

#### 4. H<sub>2</sub>S Toxicity Table

The following table shows approximate values for guidance.

#### CONCENTRATIONS OF H<sub>2</sub>S IN AIR

% by Volume	ppm by Volume	Grains per 100 std. cubic feet	Milligrams per cubic meter	Typical Characteristics Regarding H <sub>2</sub> S Exposure
0.000013	0.13	0.008	0.18	Obvious and unpleasant odor generally at 0.13 ppm and quite noticeable at 4.6 ppm. As the concentration increases, the sense of smell fatigues and the gas can no longer be detected by odor. Often referred to as the Lower Odor Threshold level.
0.001	10	0.63	14.41	Unpleasant odor. Possible eye irritation. OSHA PEL-TWA <sub>8</sub> (see 29 CFR Part 1919.1000, Table Z-1A)
0.0015	15	0-94	21.61	OSHA STEL averaged over 15 min.
0.002	20	1.26	28.83	Burning sensation in eyes and irritation of the respiratory tract after one hour or more of exposure. BOE requires audio and visual alarms and other safety measures to be employed when H <sub>2</sub> S is present at or above this concentration (30 CFR 250.490).

0.005	50	3.15	72.07	Loss of sense of smell after about 15 or more minutes exposure. Exposure over one hour may lead to headache, dizziness, and or staggering. Pulmonary edema has been reported following extended exposure to greater than 50 ppm. Exposure at 50 ppm or greater can cause serious eye irritation or damage.
0.01	100	6.3	144.14	Coughing, eye irritation, loss of sense of smell after 3-5 minutes. Altered respiration, pain in the eyes, and drowsiness after about 15-20 minutes, followed by throat irritation after one hour. Upper odor threshold. Prolonged exposure results in an increase in the severity of these symptoms. Concentration considered by NIOSH to be IDLH ( See "NIOSH Pocket Guide to Chemical Hazards", 5th edition.)
0.03	300	18.9	432.4	Maximum concentration from which one could escape within 30 minutes, without experiencing impairing or irreversible health effects if not breathing supplied air.
0.05	500	31.49	720.49	Unconsciousness after short exposure, cessation of breathing if not treated quickly. Dizziness, loss of sense of reasoning and balance. Victim will probably need prompt cardiopulmonary resuscitation (CPR).
0.07	700	44.08	1008.55	Unconscious quickly. Breathing will stop and death will result if not rescued promptly. Artificial ventilation and/or CPR needed immediately.
0.10	1000	62.98	1400.98	Unconscious at once. Permanent brain damage or death may result. Rescue promptly and apply artificial ventilation and/or CPR.

## B. SULFUR DIOXIDE

One method by which Sulfur Dioxide (SO<sub>2</sub>) is formed can be the result of burning H<sub>2</sub>S. SO<sub>2</sub> is a colorless, non-flammable gas, having a pungent odor

and characterized by an acid taste at very low concentrations. SO<sub>2</sub> in concentrations of 3-5 ppm in air is an intense irritant to humans and therefore readily detectable.

### 1. Physical Properties

CHEMICAL NAME	Sulfur Dioxide
CAS NUMBER	7446-09-05
SYNONYMS	Sulfurous Anhydride, Sulfurous Oxide
CHEMICAL FAMILY	Inorganic
CHEMICAL FORMULA	SO <sub>2</sub>
NORMAL PHYSICAL STATE	Colorless gas appreciably heavier than air. Vapor density at 32°F (0°C) and 1 atmosphere = 2.26 SG
BOILING POINT	14°F (-10.0°C)
FLAMMABLE LIMITS	Non-flammable
SOLUBILITY	Readily soluble in water and oil; solubility decreases as the fluid temperature increases.
ODOR AND WARNING PROPERTIES	Sulfur dioxide has a pungent odor associated with burning sulfur.

### 2. Exposure Limits

The OSHA established the PEL-TWA<sub>8</sub> for SO<sub>2</sub> at 2 ppm, or the STEL of 5 ppm as averaged over 15 minutes (see 29 CFR Part 1910.1000). ACGIH recommends 2 ppm as the TWA<sub>8</sub> for SO<sub>2</sub>.

### 3. Physiological Effects

- **Acute Toxicity:**

Inhalation at certain concentrations can lead to irritation, injury or death. Exposure at 50 ppm rapidly causes irritation to the mucous membranes of the nose and throat, coughing, reflex bronchi-constriction, and breathing congestion as the SO<sub>2</sub> oxidizes and hydrolyzes to sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). This SO<sub>2</sub> concentration will not be tolerated by most persons for more than 15 minutes. The severely irritating effect of the gas makes it unlikely that any person would be able to voluntarily remain in a contaminated atmosphere for long periods. The most common cause of sulfur dioxide poisoning occurs when a person is either unconscious or trapped and unable to move. Acute reactions to exposure to high concentrations are conjunctivitis, nausea, vomiting, abdominal pain, and sore throat followed by bronchitis, pneumonia and/or complaints of weakness for a period of weeks.

- **Chronic Toxicity:**

Reports indicated that prolonged exposures to SO<sub>2</sub> may contribute to alterations in the sense of smell and taste, shortness of breath on exertion, and a higher frequency of respiratory infections compared to unexposed persons. SO<sub>2</sub> in the work environment may “possibly” enhance the suspected carcinogenic effect of arsenic and other cancer agents.

#### 4. SO<sub>2</sub> Toxicity Table

**NOTE: Any pre-existing chronic respiratory impairment must be considered in regard to job placement since these conditions can be aggravated by exposure to sulfur dioxide.**

#### CONCENTRATIONS OF SO<sub>2</sub> IN AIR

% by Volume	PPM by Volume	Grains per 100 std. cubic feet	Milligrams per cubic meter	Typical Characteristics Regarding SO <sub>2</sub> Exposure
0.0001	1	0.012	2.71	Pungent odor, may cause respiratory changes
0.002	2	0.24	5.42	OSHA PEL-TWA <sub>8</sub> (see 29 CFR Part 1910.1000, Table Z-1A) and ACGIH recommended TLV.
0.0005	5	0.59	13.50	Burning eyes, breathing irritation and minor throat irritation. OSHA STEL averaged over 15 minutes (see 29 CFR Part 1910.1000, Table Z-1A).
0.0012	12	1.42	32.49	Throat irritation, cough, constriction in chest, watering eyes, and nausea.
0.010	100	12.00	271.00	This is the maximum concentration from which one could escape within 30 minutes, without experiencing impairing or irreversible health effects without supplied breathing air. Concentration considered IDLH (see “NIOSH Pocket Guide to Chemical Hazards”, 5th edition).
0.015	150	17.76	406.35	Extreme irritation. Can be tolerated for only a few minutes.
0.05	500	59.2	1354.50	Causes a sense of suffocation, even with the first breath. Rescue promptly and apply artificial ventilation and/or CPR.
0.10	1000	118.4	2708.99	Death may result unless rescued promptly. Apply artificial ventilation and/or (CPR) immediately.

## V. H<sub>2</sub>S TRAINING

At the docks and on the *Discoverer*, each individual will be asked if they have been cleared by a physician to use a respirator. This requirement will be the responsibility of each company or individual before coming aboard the drillship.

Each person will be informed on the restrictions of having beards and wearing contact lenses. They will also be informed of the availability of spectacle kits.

The safety program is outlined in the H<sub>2</sub>S Contingency Plan. This plan will be available on the rig. Each individual will be briefed on the H<sub>2</sub>S Contingency Plan and sign the [“Contingency Plan Memorandum of Understanding”](#).

After the H<sub>2</sub>S equipment is rigged up, all personnel will be H<sub>2</sub>S trained and put through a drill. Any deficiencies will be corrected.

Training Completion cards are good for one year and will indicate date of training completion or expiration. Personnel previously trained on another facility and visiting the *Discoverer* must attend a “supplemental briefing” on H<sub>2</sub>S equipment and procedures before beginning duty. Visitors without current H<sub>2</sub>S certification who remain on the facility more than 24 hours must receive full H<sub>2</sub>S training given all crew members. A “supplemental briefing” will include but not be limited to the location, use and donning of an assigned respirator, familiarization with safe briefing areas, alarms with instruction on responsibilities in the event of a release and hazards of H<sub>2</sub>S and SO<sub>2</sub>.

Topics for full H<sub>2</sub>S training shall include, but not limited to the following:

- A. Brief Introduction of H<sub>2</sub>S
  1. Slide or VCR presentation (If available)
  2. H<sub>2</sub>S Material will be distributed
  3. Re-emphasize the properties, toxicity, and hazards of H<sub>2</sub>S
  4. Source of SO<sub>2</sub>
- B. H<sub>2</sub>S Detection
  1. Description and sensitivity of H<sub>2</sub>S sensors
  2. Description of warning system (how it works and its location)
  3. Actual location of H<sub>2</sub>S sensors
  4. Instruction on use of pump type detector
  5. Use of card detectors, ampoules, or dosimeters
  6. Use of combustible gas detector
  7. Other personnel detectors
  8. Alarm conditions I, II or III (10 ppm, 20 ppm or 50 ppm)



9. SO<sub>2</sub> (2 ppm and 5 ppm)
- C. H<sub>2</sub>S Protection
    1. Types of breathing apparatus provided (30-minute SCBA & SKA PAK with voice diaphragms for communication)
    2. Principle of how breathing apparatus works
    3. Demonstration on how to use breathing apparatus
    4. Location of breathing apparatus
  - D. Cascade System
    1. Description of a typical cascade system
    2. How the system works
    3. Cascade locations on the drillship with reference to briefing areas
    4. How to use cascade system (with SKA PAKS & refill)
    5. Importance of wind direction and location of windsocks
    6. Purpose of compressor/function
  - E. H<sub>2</sub>S Rescue and First Aid
    1. Importance of wind direction
    2. Safe briefing area
    3. “Buddy” System
    4. H<sub>2</sub>S symptoms
    5. Methods of rescue
  - F. Hands on Training
    1. Donning/familiarization of SCBA
    2. Donning/familiarization of Escape/Work unit
    3. Familiarization with cascades
    4. Use of O<sub>2</sub> resuscitator
    5. Alarm conditions – upwind briefing areas, etc.
    6. Duties and responsibilities of all personnel
    7. Procedures for evacuation
    8. Search and Rescue teams
  - G. Certification
    - A. Testing on material covered

## VI. SAFETY EQUIPMENT

A summary of procedures and equipment that will be operational at compliance depth is as follows:

### A. Muster Areas

The AFT Muster area will be in the Galley. The FWD Muster area will be in the Forward Foyer which is located in the bow area of the ship. Personnel AFT of the moonpool will use the AFT Muster area; personnel FWD of the moonpool will use the FWD Muster area.

### B. Safe Briefing Areas

Two areas will be designated as "SAFE BRIEFING AREAS". The AFT Briefing Area will be located on the AFT Main Deck below the Helicopter Deck. The FWD Briefing Area will be located on the Main Deck Bow. Personnel AFT of the moonpool will use the AFT Briefing Area; personnel FWD of the moonpool will use the FWD Briefing Area. Drawings of the rig are included in the Appendix.

### C. Wind Direction Indicators

Windssocks will be installed on the vessel. They will be positioned as to be seen from any location on the main deck, rig floor and heliport.

### D. Danger Signs

Four 4' x 8' danger signs will be displayed from all sides of the vessel in a manner visible to watercraft and aircraft. The signs will be yellow with the following warning painted in 12" high black, block lettering.

**DANGER POISONOUS GAS  
HYDROGEN SULFIDE  
DO NOT APPROACH IF RED LIGHTS ARE FLASHING**

Signs are worded as per the regulation. Signs are photo luminescent. The danger signs will be displayed at compliance depth. If the H<sub>2</sub>S concentration exceeds 20 ppm at the surface, four 2' x 3' red light panels will be flashing visible to marine traffic, aircraft & personnel on the drillship. Red flags will not be used; red lights will. All signs will be illuminated under conditions of poor visibility and at night. Signs will be posted indicating the safe briefing areas and Condition I, II and III signals, as designated in [Section B-1](#) of the Appendix.

#### E. Operating Condition Signs

Operating Condition posters indicating Condition I, II, and III will be located in the following areas:

1. Each level of the living quarters
2. Rig floor
3. Mud pit area
4. Engine room area
5. Work areas on the Main Deck
6. Mud pump area
7. Galley
8. Moonpool
9. Transit room
10. Recreation room
11. Shale shaker

#### F. H<sub>2</sub>S Detectors and Alarms

The gas detection control panel will be located in the Emergency Response Room. Annunciator panels will be located in the following locations:

1. Company representative office
2. Toolpusher's office
3. Toolpusher's quarters

Continuous monitoring type H<sub>2</sub>S detectors, capable of sensing a minimum of 10 ppm H<sub>2</sub>S in air, will be located at each of the following points:

1. Rig floor/ Driller's station
2. Rig floor/ bell nipple
3. Mud return line/ gumbo box
4. Trip tank
5. Shale shaker 1
6. Shale shaker 2
7. Possum Belly
8. Active pit
9. Pump room
10. Sack room

11. Cement unit/Dive control area
12. Bridge Intake
13. Aft Quarters
14. Forward Quarters
15. Quarters Intake HVAC
16. Moonpool
17. Engine room intake

All detectors will be tested once every 24 hours. If tests are not within 2 ppm or 10 percent, whichever is greater, then that sensor will be recalibrated.

Automatic H<sub>2</sub>S Alarms (Visible and Audible) will be located at the following points:

1. Rig floor
2. Sack room
3. Active pit
4. Shaker area
5. Pump room
6. Engine room
7. Cement unit /Dive control area
8. Mud logging unit
9. Navigation Bridge Deck (2)
10. Quarters Bridge Deck (3)
11. Quarters Boat Deck (2)
12. Quarters Poop Deck (2)
13. Quarters Main Deck (2)

Alarms will be suitable for the electrical classification of the area where they are installed. An alarm station will be located in the control house. Upon verification of the alarm, the ship's gas alarm system will be engaged.

#### G. Flare Line Piping

Prior to compliance depth, the degasser and the mud-gas separator will be rigged so the gas can be flared if H<sub>2</sub>S is encountered in concentrations equal to, or exceeding, 20 ppm. A remote electronic ignition device will be available along with an alternate backup method for igniting the flare (handheld flare gun). The Flare outlet must be a diameter that allows easy non-restricted flow

of gas. SO<sub>2</sub> monitor readings will be taken using a portable instrument on an hourly basis and logged in reports.

Blowout Prevention Equipment- The blowout preventers, integral choke and kill lines, and surface manifold are designed for H<sub>2</sub>S service in case it becomes necessary to circulate a kick.

#### H. H<sub>2</sub>S Service Equipment

**N/A (Refer to 30 CFR 250.490 (p) which specifies that this equipment is required for areas classified as “H<sub>2</sub>S PRESENT” or “H<sub>2</sub>S UNKNOWN”)**

#### I. H<sub>2</sub>S Scavengers

A supply of zinc oxide, or an equivalent, will be stored aboard the rig in case the mud becomes contaminated with H<sub>2</sub>S. A detailed mud treating procedure is given in [Section A-3](#) of the Appendix. After reaching compliance depth, a sufficient volume of zinc oxide will be maintained aboard the rig to treat the entire system twice with two pounds per barrel (ppb). If water-based drilling fluids are used and ambient air sensors detect H<sub>2</sub>S either the Garrett-Gas-Train test or comparable test for soluble sulfides must immediately be conducted to confirm the presence of H<sub>2</sub>S.

#### J. Breathing Air Cascade System (BACS) consists of the following:

1. Grade D/E breathing air compressor
2. Breathing air cascade storage cylinders
3. Interconnection and distribution hose or tubing
4. Distribution panels
5. Manifolds

The BACS utilizes central storage cascade cylinders and a closed loop high pressure cascade to supply breathing air to the distribution panels located about the vessel. Distribution panels reduce the high pressure air to working pressure for distribution to the manifolds.

1. Safe Briefing Areas, Forward and Aft (12 ea. 12-outlet and one 6-outlet)
2. Shale shaker area (2 ea. 3-outlet)
3. Drill floor (2 ea. 12-outlet) and 2 ea. 8-cylinder cascades
4. Derrick (3-outlet)
5. Racking cabin (3-outlet)
6. Pump room (6-outlet)
7. Pit room (6-outlet)

8. Sack room (6-outlet)
9. Mud logging unit (6-outlet)
10. Moon Pool (6-outlet)
11. Bridge (6-outlet)
12. Dive Deck Location (6-outlet)
13. Dive Control Van (6-outlet)
14. Dive Launch & Recovery System (LARS) (6-outlet)

There will also be a breathing air cascade system located on a standby vessel to support an evacuation of all personnel aboard the *Discoverer* and vessel crew aboard the standby vessel. The vessel will make optimum use of staying upwind during H<sub>2</sub>S operations. Breathing air compressors will be located near the Briefing Areas for refill. All 444 ft<sup>3</sup> (cu ft) breathing air cylinders will be labeled: Safe Breathing Air; Grade D/E Breathing Compressed Air for Human Use.

#### K. Safety Equipment

Chalkboards and/or notepads for communication are located on the rig floor, shale shaker area, the cement room, and the pump room. Bullhorn, safety litter, first aid kits, resuscitators, safety harnesses and voice transmission devices will be kept in the ship's infirmary and/or Shell's gang box. The list of safety equipment (including breathing air equipment, resuscitators, H<sub>2</sub>S and SO<sub>2</sub> detectors, and explosion meters, flare guns, etc.) are listed in [Section C](#) of the Appendix.

#### L. Metallurgical Properties of Equipment

**N/A (Refer to 30 CFR 250.490 (p) which specifies that this equipment is required for areas classified as “H<sub>2</sub>S PRESENT” or “ H<sub>2</sub>S UNKNOWN”)**

When operating in a zone with H<sub>2</sub>S present, equipment will be used that is constructed of materials with metallurgical properties that resist or prevent sulfide stress cracking, chloride stress cracking, hydrogen-induced cracking and other failure modes. The following will be in effect:

- Tubulars and other equipment, casing, tubing, drill pipe, couplings, flanges, and related equipment should be designed for H<sub>2</sub>S service.
- Temporary downhole well security devices such as retrievable packers and bridge plugs should be designed for H<sub>2</sub>S service.
- Wireline lubricators, which may be exposed to fluids containing H<sub>2</sub>S, must be of H<sub>2</sub>S-resistant materials.
- H<sub>2</sub>S-resistant materials will be used for all elastomer seals.

- Deck drains must be equipped with traps or similar devices to prevent the escape of H<sub>2</sub>S gas into the atmosphere.
- Precautions will be taken to eliminate sealed voids in piping designs, such as slip on flanges, reinforcing pads, which can be invaded by atomic hydrogen when H<sub>2</sub>S is present.

#### M. Fans

Movable ventilation devices will be provided in work areas. Devices will be capable of dispersing H<sub>2</sub>S or SO<sub>2</sub> vapors away from working personnel. Areas may include rig floor, mud pit, shale shake, and cement unit areas. All ventilation devices will be explosion proof.

#### N. Forced Air Control Switch

All forced air systems will be shut down upon detection of 20 ppm or greater (mud logging unit, quarters, and any other forced air control switches should be shut off.)

#### O. Attending Vessels

Vessels that are stationed **overnight** alongside the *Discoverer* will be equipped with an H<sub>2</sub>S detection system that activates audible and visual alarms when the concentration of H<sub>2</sub>S in the atmosphere reaches 20 ppm. This requirement does not apply to vessels that are **not** stationed alongside overnight or to vessels positioned upwind and at a safe distance from the facility in accordance with the positioning procedure described in the approved H<sub>2</sub>S Contingency Plan.

Attending vessels will be identified prior to the commencement of drilling operations and listed in an updated contingency plan. Time along side the *Discoverer* will be in compliance with the Air Permit issued by the Environmental Protection Agency.

## VII. NORMAL OPERATING PROCEDURES

#### A. Emergency Phone List

Lists of emergency phone numbers will be sent to the drillship and should be posted at the following locations: Emergency Room, Radio Room, Drillship Master's office, Noble Drilling Superintendent's office, Shell Drilling Foreman's office, Shell SIMOPS Coordinator's office and all Support Vessels. Copies will be available in the Shell and Noble Anchorage and Houston offices as well.

## B. Safety Equipment

All safety equipment and H<sub>2</sub>S related hardware must be set up as outlined under [Section V](#) “Safety Equipment”. All safety equipment must be inspected routinely, paying particular attention to resuscitators and breathing air equipment. SCBAs will be pressure-demand-type with hose-line capability rated for at least 30 minute duration.

## C. Supplied Air Breathing Equipment

All personnel on board will be assigned breathing air equipment and, if needed, lead-acetate spot check. Shell and rig contractor personnel required to work in the following areas will be provided with work/escape type air line equipment with 10-minute escape duration. These units are in addition to their assigned 30-minute rated units.

1. Rig floor
2. Mud pit area
3. Mud pump room
4. Sack storage area
5. Cementing area
6. Engine room
7. Shale shaker area
8. Mud logging unit
9. Dive Launch and Recovery System (LARS)
10. Dive control van
11. Decompression chamber
12. Dive deck work area
13. Bridge

## D. Training

Prior to the initiation of drilling operations, all personnel must be thoroughly trained in the use of breathing air equipment, emergency procedures, responsibilities, and first aid for H<sub>2</sub>S victims. All personnel when coming on board will immediately receive H<sub>2</sub>S training or a supplemental briefing. The H<sub>2</sub>S Safety Technician must keep a list of all who have been through the special training programs on board the rig.

Documentation of training must be provided by the service company. All personnel will be briefed on the Contingency Plan and sign a copy of the [“Contingency Plan Memorandum of Understanding”](#), in [Section B-1](#) of the



Appendix. This document summarizes the steps to be taken during the three conditions under which the drillship may operate. It lists general information about toxic gases, explains the physiological effects of H<sub>2</sub>S, [operating conditions](#) as defined by the H<sub>2</sub>S contingency plan, and informs each reader of his general responsibilities concerning safety equipment and emergency procedures.

#### E. Testing

Below compliance depth the H<sub>2</sub>S detection system will be tested every 24 hours under normal conditions. The H<sub>2</sub>S detectors will be calibrated weekly. In the event that H<sub>2</sub>S is detected, or when drilling a zone containing H<sub>2</sub>S, the units will be tested at least once every 24 hours. The time and results of each test or calibration will be logged by the H<sub>2</sub>S Technician and reported each day to the Shell Drilling Foreman. The Shell Drilling Foreman will ensure that the H<sub>2</sub>S detection equipment calibrations and tests are recorded on the IADC Daily Drilling Report Form and Morning Report. In the event that an H<sub>2</sub>S detector does not test successfully, operations will cease until:

- The detector is repaired
- Approval to proceed is received from the Shell Drilling Foreman, as per the 30 CFR 250.490.

#### F. Reporting Aboard the Drillship

When boarding the vessel from either boat or helicopter, all personnel, without exception, must proceed directly to the H<sub>2</sub>S Safety Technician for assignment of breathing air equipment and, if needed, ampoules or equivalent H<sub>2</sub>S detector. An instruction and orientation briefing will also be held, if needed (See section on training requirements). The H<sub>2</sub>S Safety Technician will be responsible for assigning equipment to the individuals and instructing them in its use.

#### G. Breathing Air Equipment

Each person aboard the drillship will be instructed in the use of breathing air equipment until supervisory personnel are satisfied that each is capable of using the equipment. The training must include all additional personnel that are allowed aboard the drillship during drilling operations.

After familiarization, each on-duty rig and roustabout crew must perform a weekly drill with breathing equipment. The drill will include such topics as securing the breathing air equipment, putting it on, and working for a short period, doffing the equipment, cleaning and storing it for future use. A record should be kept of the crews drilled and the date. A complete "[BREATHING AIR EQUIPMENT DRILL](#)" procedure is given in [Section B-2](#) of Appendix.

## H. Drills

Along with normal weekly fire drills and safety meetings, weekly breathing air equipment drills and H<sub>2</sub>S training sessions must be held for all personnel and a record of attendance must be kept. Visitors will be given a supplemental briefing even if they hold a valid H<sub>2</sub>S card. However, if the visitor stays more than 24 hours, then full H<sub>2</sub>S briefing and orientation will be required for the visitor. An explanation of these drills and training sessions and a list of what they include are provided in [Section B-3](#) of the Appendix.

## I. Spare Equipment

Rig crews and service company personnel should be aware of the location of spare breathing air bottles, resuscitation equipment, portable fire extinguishers, and H<sub>2</sub>S detectors. Knowledge of the location of H<sub>2</sub>S detector monitors is vital to understanding the “emergency conditions”. In addition, key personnel must be trained in the use of the resuscitator and H<sub>2</sub>S detector ampoules.

## J. Spot Checks

H<sub>2</sub>S spot checks shall be available for use by working personnel. After H<sub>2</sub>S has been initially detected by any device, periodic inspections of all areas of poor ventilation shall be made with a portable H<sub>2</sub>S detector instrument.

## K. Wind Direction

All personnel on the location shall become “wind conscious” and must be aware of the direction of the prevailing winds at all times. They should remember that H<sub>2</sub>S is heavier than air and will collect in low places in still air. The *Discoverer* has a turret system which enables it to maintain a position with the bow into wind/seas as needed, so wind direction for the most part will run from forward to aft.

Therefore, the primary Safe Briefing Area will be forward of the moonpool. Personnel will report to the closest Safe Briefing Area. Personnel forward of the moonpool will report to the forward Safe Briefing Area and personnel aft of the moonpool will report to the aft Safe Briefing Area. Should an evacuation become necessary, procedures for evacuation are outlined in Section IX, H<sub>2</sub>S Emergency Procedures.

## L. Welding Prohibition

There should be no welding, if H<sub>2</sub>S is detected at the surface, until the surrounding air is thoroughly tested with combustible gas and handheld H<sub>2</sub>S meter(s).

## VIII. OPERATING CONDITIONS-Classifications

### A. Possible Hazardous Conditions (H<sub>2</sub>S Not Present)

1. Warning Signs: None
2. Alarm: None
3. Characterized By: Routine drilling operations under control in zones that are classified as "H<sub>2</sub>S present" or "H<sub>2</sub>S unknown". This condition will be in effect continuously from the base of the structural casing (as described in the APD) to total depth unless it is necessary to go to a Condition I, II, or III.
4. General Action:
  - a. HSE Technicians and H<sub>2</sub>S technicians monitor H<sub>2</sub>S concentrations using the fixed gas detection system
  - b. Be alert for a condition change
  - c. Keep all safety equipment available and monitors functioning properly

### B. **Condition I:** Potential Danger (H<sub>2</sub>S Present ≥10 ppm but < 20 ppm)

1. Warning Sign:

"DANGER – POISONOUS GAS - HYDROGEN SULFIDE – DO NOT APPROACH IF RED LIGHTS ARE FLASHING" signs will be displayed on all sides of drillship (yellow with black lettering to be illuminated at night) and under conditions of poor visibility.
2. Alarms:

In work areas: BLUE FLASHING LIGHT. Alarm signals will continue as long as the H<sub>2</sub>S concentration is greater than 10 but less than 20 ppm or until deactivated by the H<sub>2</sub>S Safety Technician or the Shell Drilling Foreman. Announcement will be made on ship's PA system advising all personnel of the situation.
3. Characterized By:

Drilling operations area under control. Poisonous gases may be present in concentrations at threshold levels and may or may be detectable by odor. This condition will be in effect continuously from the time the H<sub>2</sub>S concentration reaches 10 ppm unless it is necessary to go to Condition II or III. NOTE: It is unlikely that a continuous concentration of H<sub>2</sub>S during exploration drilling operations will be tolerated for an extended time periods. Shell will take remedial efforts to stop the influx of H<sub>2</sub>S, up to and

including well abandonment, if Condition I persists. Action to be taken under Condition I is contained under [Section VII “H<sub>2</sub>S Emergency Procedures”](#).

4. General Action:
  - a. Be Alert for a condition change.
  - b. Check safety equipment for proper functioning. Keep available for immediate use.
  - c. Monitor H<sub>2</sub>S concentrations for general increases during drilling operations.
  - d. Follow the instructions of the supervisor.

C. **Condition II: Moderate Danger to Life (H<sub>2</sub>S Present ≥20 ppm but < 50 ppm)**

1. Warning Sign:

“DANGER – POISONOUS GAS - HYDROGEN SULFIDE – DO NOT APPROACH IF RED FLAG IS FLYING OR IF RED LIGHTS ARE FLASHING” signs will be in place on all sides of the drillship (Yellow with black lettering to be illuminated at night and under conditions of poor visibility.) Two foot by three foot red flags will also be displayed.

2. Alarm:

Continuous sounding of the H<sub>2</sub>S siren (yelping tone) and RED LIGHT flashing. All alarm signals will continue as long as the H<sub>2</sub>S concentration is present at 20 ppm or more or until deactivated by the H<sub>2</sub>S Safety Technician or the Shell Drilling Foreman. The Vessel Master will manually trip the ship’s gas alarm. Announcement will be made on ship’s PA system advising all personnel of the situation.

3. Characterized By:

Critical well operations are underway or well control problems. Toxic gases are present above threshold levels. This condition shall be in effect when the H<sub>2</sub>S concentration is present at 20 ppm but less than 50 ppm.

4. General Action:

At a concentration of 20 ppm (15 minute time-weighted average) the BOE and USCG will be notified. The Vessel Management Team (VMT) will standby in the Operations Center to assist in developing H<sub>2</sub>S control procedures. Personnel assigned to control the H<sub>2</sub>S source will don SCBAs or facemasks with a hoseline connection. All others will don SCBA then report to the Safe Briefing Area with immersion suit and personal flotation device.

**D. Condition III: Extreme Danger to Life (H<sub>2</sub>S Present ≥ 50ppm)**

## 1. Warning Sign:

“DANGER – POISONOUS GAS – HYDROGEN SULFIDE – DO NOT APPROACH IF RED LIGHTS ARE FLASHING” signs will be in place on all sides of drillship (Yellow with black lettering to be illuminated at night and under conditions of poor visibility).

## 2. Alarm:

Continuous sounding of the H<sub>2</sub>S alarm (Yelping Tone) with BLUE AND RED LIGHTS flashing. All alarm signals will continue as long as the H<sub>2</sub>S concentration is present at greater than 50 ppm, or until deactivated by the H<sub>2</sub>S safety technician or the Shell Drilling Foreman. The Vessel Master will manually trigger the ship’s gas alarm. Announcement will be made on ship’s PA system advising all personnel of the situation.

## 3. Characterized By:

Loss of well control or released H<sub>2</sub>S concentration is greater than 50 ppm.

## 4. General Action:

- a. The evacuation vessel will be contacted for assistance with evacuation.
- b. The BOE and USCG will be notified.
- c. The Shell SIMOPS Coordinator will be notified (907-382-4130)
- d. The Incident Command Team (ICT) in Shell’s Anchorage Office will be notified.
- e. All non-essential personnel (or all personnel if the situation warrants) shall be evacuated. Radio and other available communications shall be used to alert all air and water craft in the immediate vicinity of the rig. The Shell Drilling Foreman will advise the Anchorage Incident Command Team of plans to evacuate the rig.
- f. Evacuation will be conducted by moving personnel from *Discoverer* to the standby evacuation vessel.
- g. All people not specifically assigned to correct or control the situation shall stay in the Designated Muster Area or Safe Briefing Area as instructed, until evacuated by a rescue vessel or escape capsule. A suggested list of essential personnel to be left aboard is listed in Section IX. The number of essential personnel may be increased at the request of the Vessel Master, Noble Drilling Superintendent or Shell Drilling Foreman, as necessary.
- h. If the alarm sounds and it has not been preceded by Condition II, the actions of Conditions II shall be taken. Circulation will be stopped and self-contained breathing apparatus and air line work units shall be donned by all working personnel. The Drilling Contractor Safety

Representative shall check all personnel by roster. Vessels will be notified. The rig and shore dispatchers will also be notified of the condition and will continuously monitor the radio.

- i. If the flare is ignited, the burning or hydrogen sulfide will be converted to sulfur dioxide which is also poisonous. **DO NOT ASSUME THAT THE AREA IS SAFE AFTER THE GAS IS IGNITED. CONTINUE TO OBSERVE EMERGENCY PROCEDURES.** Follow the instructions of Supervisors.

## IX. H<sub>2</sub>S EMERGENCY PROCEDURES

### A. Condition I

If at any time 10 ppm or more (up to 20 ppm) of H<sub>2</sub>S is detected, the following steps will be taken:

1. The person detecting the H<sub>2</sub>S must IMMEDIATELY notify the driller. The driller will, in turn, notify the Toolpusher and/or the Drilling Superintendent who will then notify the Shell Drilling Foreman and SIMOPS Coordinator.
2. Central Control Room notifies ship of Condition I via the ships PA system.
3. Orient the drillship relative to wind direction to minimize H<sub>2</sub>S exposure.
4. The H<sub>2</sub>S technician will establish communication with the control room, notifying the PIC of his intent to confirm H<sub>2</sub>S presence in the area of the alarm.
5. The H<sub>2</sub>S Technician and designated buddy shall put on their self-contained breathing apparatus and take hand held detectors to the sensor area registering H<sub>2</sub>S, and verify the presence and source of the H<sub>2</sub>S. **The buddy system will be used.**
6. The driller will shut down the mud pump, pick up to space out position and continue to rotate the drill pipe.
7. The following personnel will immediately put on their breathing air units.
  - a. All personnel on the rig floor.
  - b. All personnel at the mud pits and shale shaker area.
  - c. All personnel in the moon pool area.
  - d. All personnel not in areas listed above will receive instruction via the PA, as to necessary response to the alarm.

**NOTE: At the discretion of the Vessel Master, Drilling Superintendent, and/or Shell Drilling Foreman, the H<sub>2</sub>S Safety Technician may give the OK to doff the SCBA should the**

**conditions warrant. SCBAs will be worn “at the ready” until an “all clear” is given.**

8. The Vessel Master, Noble Drilling Superintendent, or designee will alert all personnel in work areas that a Condition I exists. He shall be prepared to shut off the forced air circulation system and close all hatches downwind of, and below, the source of H<sub>2</sub>S.
9. The Mud Engineer will run a Sulfide Determination on the flowline mud using a Garrett Gas Train provided by the mud supplier or catch a closed mud sample and pull a Sensidyne or similar ampoule to confirm the presence of H<sub>2</sub>S. **The Mud Engineer will don proper PPE, to include SCBA, while retrieving a sample of flow line mud to perform the test.**
10. The Shell Drilling Foreman and Toolpusher will prepare plans to suppress the H<sub>2</sub>S as quickly as possible. Drilling operations must not proceed until the source of the H<sub>2</sub>S is determined and the well is circulated. Rig floor mud pit and shale shaker personnel will keep breathing air equipment on while monitoring this circulation.
11. The Vessel Master, Noble Drilling Superintendent or designee will make sure all non-essential personnel are out of the potential danger area (mud pit area, mud storage room, store room, etc.). All personnel who remain in the potential danger area must use the “Buddy System”.
12. The Shell Drilling Foreman shall notify the Shell Drilling Superintendent of current conditions and action taken who will then notify the Shell SIMOPS Coordinator.
13. The H<sub>2</sub>S Safety Technician will see that all monitoring devices are functioning properly and reading accurately and will increase gas monitoring activities with portable units.
14. The Shell Drilling Foreman or Noble Drilling Superintendent, shall direct the drillship dispatcher, or the local Call and Communication Center onshore to notify all boats in the area to go upwind, to **stay on power** and to maintain a continuous radio and visual watch.
15. The Shell Drilling Foreman or Noble Drilling Superintendent shall direct the drillship dispatcher and the Shell SIMOPS Coordinator ,the local Aviation Logistics Base onshore to notify aircraft enroute to the drillship of current conditions and the action to be taken.

16. “DANGER – POISONOUS GAS - HYDROGEN SULFIDE – DO NOT APPROACH IF RED LIGHTS ARE FLASHING” warning signs must be posted on all sides of the drilling rig.
17. The Shell Drilling Foreman, Vessel Master or Noble Drilling Superintendent will alert the dispatcher to assure continuous radio and phone watch.

**B. Condition II and III**

If the H<sub>2</sub>S Concentration reaches 20 ppm, and the well is NOT attempting to flow, the following steps will be taken in addition to those steps listed above for Condition I.

1. The person detecting the H<sub>2</sub>S must IMMEDIATELY notify the driller. He must then notify Vessel master, Noble Drilling Superintendent and the Shell Drilling Foreman who will then notify the Shell SIMOPS Coordinator.
2. Automatic audible and visual alarms in the listed areas of the drillship.
3. The Central Control Room activates ship-wide gas alarm system and announces change of condition.
4. The ship’s crew will orient drillship relative to wind direction to minimize H<sub>2</sub>S exposure.
5. The driller will shut down the mud pump, pick up to space out position and continue to rotate the drill pipe.
6. All personnel will receive instruction via the PA, as to necessary response to the alarm.
7. Once breathing air equipment has been donned, the driller should:
  - a. Stop pipe rotation
  - b. Space out for well control
  - c. Be ready to close the BOP’s
  - d. Follow the “Well Control Procedure” in [Section A-1](#) of the Appendix if well control problems develop.
8. The Vessel Master, Shell Drilling Foreman, Noble Drilling Superintendent, or designee will alert all personnel in work areas that a Condition II or III exists. He shall be prepared to shut off the forced air circulation system and to close all hatches downwind of, and below, the source of H<sub>2</sub>S.



9. All personnel outside of the living quarters and not listed above, must get their Type I Life Jacket and assigned SCBA, and report to the designated muster area for further instructions. If both the assigned SCBA and the safe briefing area are upwind of the wellbore, the SCBA may be carried to the designated muster area; however, if there is any doubt, the SCBA should be donned and activated immediately. If it becomes necessary to go through/across the moon pool area, rig floor or mud circulating area to get to the designated muster area, the nearest breathing air equipment available is to be donned. Under a Condition II situation, those personnel inside the living quarters will secure their SCBA and Type I life jackets and proceed to the designated muster area. Under a Condition III, all personnel inside the living quarters will go to the designated muster area with air equipment on and then proceed to the appropriate safe briefing area, as directed by the Person In Charge (PIC). Once at the safe briefing area, personnel should plug-in, close SCBA cylinder valves, and use the Cascade System. An effort should be made to conserve air still stored in the SCBA cylinder.
10. Persons should always put on breathing air equipment before assisting someone affected by H<sub>2</sub>S gas, and use the “buddy system”. If the affected person is stricken in a high concentration area, a safety belt with 50’ of tail line should be worn by the rescuer who should obtain standby assistance before entering the area. The “buddy system” must always be used when entering possibly contaminated areas.
11. The Shell Drilling Foreman, Vessel Master or Noble Drilling Superintendent shall direct the drillship dispatcher, and the Shell SIMOPS Coordinator to notify all boats in the area to go upwind to **stay on power** and to maintain a continuous radio and visual watch.
12. The Shell Drilling Foreman, Vessel Master or Noble Drilling Superintendent shall direct the rig dispatcher, and the Shell SIMOPS Coordinator to notify aircraft enroute to the drillship of current conditions and the action to be taken.
13. The “DANGER – POISONOUS GAS - HYDROGEN SULFIDE – DO NOT APPROACH IF RED LIGHTS ARE FLASHING” signs on all sides of the drillship are to be displayed.
14. The Shell Drilling Foreman, Vessel Master or Noble Drilling Superintendent will alert the radio operator to establish a 24-hour

radio and phone watch. The radio operator shall alert vessels and the Shell SIMOPS Coordinator to standby for possible evacuation.

15. Evacuate non-essential personnel when H<sub>2</sub>S reaches a concentration exceeding 50 ppm in the air. A personnel basket will be used to evacuate to the evacuation vessel(s). All personnel will stay in their SCBAs until the vessel is moved upwind away from the drillship and the all clear is sounded. Personnel will “plug-in” to the Breathing Air Cascade system on the evacuation vessel, closing the SCBA valves and using the supplied air via the Breathing Air Cascade system to conserve stored air in the SCBA. Life boats (capsules) will be used if the evacuation vessel is not readily available or if conditions require.
13. The Shell Drilling Foreman will assess the situation and assign duties to each person needed to bring the situation under control. When the severity of the situation has been determined, all persons will be advised. The Shell Drilling Foreman or his designated representative will:
  - a. Continue to direct corrective action to bring the situation under control
  - b. Notify the Shell Drilling Superintendent of the situation and results
14. The Shell Drilling Superintendent will be responsible for notifying the following regulatory agencies:
  - a. BOEMRE (Anchorage District)
  - b. U.S. Coast Guard
  - c. Alaska Department of Natural Resources
  - d. All other required agency
  - e. Shell SIMOPS Coordinator
15. If an H<sub>2</sub>S concentration exceeding 50 ppm in the air is recorded at the outer perimeter of the drillship, all known air and water craft in the immediate vicinity of the drillship location will be notified by marine radio and directed to move upwind immediately.

### C. Evacuation Procedures

1. An order to evacuate the vessel will be given by the Vessel Master.
2. Evacuation will be conducted via personnel basket transfer from the *Discoverer* to the evacuation vessel (to be determined).
3. Personnel will open their SCBA cylinder valve and disconnect from the *Discoverer's* cascade manifolds immediately prior to boarding the personnel basket for transfer.

4. Upon transfer to the evacuation vessel each person will be directed to the H<sub>2</sub>S muster area and connect their SCBA to the breathing air manifolds, then close their SCBA cylinder.

## **X. SPECIAL OPERATIONS**

### **A. Other Operations**

1. Logging Operations: Drilling fluid should be treated with H<sub>2</sub>S scavenger prior to logging to minimize the corrosive/embrittling effects of H<sub>2</sub>S on the wireline and logging tools.
2. Stripping Operations: Personnel must monitor displaced drilling fluid returns and wear protective breathing equipment in the working area when the atmospheric concentration of H<sub>2</sub>S reaches 20 ppm or if the well is under pressure.
3. Gas-cut drilling fluid or a well kick from H<sub>2</sub>S-bearing zone: When, and if, a decision is made to circulate out a kick, personnel in the working area during bottoms-up and extended-kill operations must wear protective breathing equipment

### **B. Monitor Observation During Specific Operations**

During drilling operations the H<sub>2</sub>S levels indicated by the monitors must be continuously observed during the following operations after penetrating a zone where H<sub>2</sub>S was identified during drilling:

1. When pulling a wet string of drillpipe
2. When circulating bottoms-up after a drilling break
3. During cementing operations (including abandonment)
4. During logging operations
5. When circulating to condition drilling fluid

## **XI. WELL CONTROL**

The following well control practices should be initiated:

### **A. Trip Gas**

If high trip gas or high connection gas concentrations are encountered, the degasser should be used and the gas separated and burned if that is the best course of action.

**B. All Kicks**

Assume any influx of formation fluid into the wellbore contains H<sub>2</sub>S. When the decision is made to circulate out the influx, all personnel involved will don breathing air equipment from the time the influx reaches the BOP until it is determined whether H<sub>2</sub>S is present. The following steps should be taken when the influx occurs:

1. Shut in the well using normal techniques. Record drill pipe pressure, casing pressure, and volume of influx.
2. Notify The Shell Drilling Foreman, the Noble Drilling Superintendent and the Shell SIMOPS Coordinator.
3. If directed to circulate out the influx, proceed as outlined in the “Well Control Procedure” in [Section A-1](#) of the Appendix.

If the mud has been contaminated with H<sub>2</sub>S, it may be necessary to treat it with zinc basic carbonate (or equivalent) to treat out the H<sub>2</sub>S. A “Mud Treating” procedure is given in [Section A-3](#) of the Appendix.

**XII. LOST CIRCULATION**

If the lost circulation occurs, proceed as outlined in the “Lost Circulation Procedure” in [Section A-2](#) of the Appendix.

**XIII. PARTIAL EVACUATION PROCEDURE**

In the event that it becomes necessary to evacuate the rig due to well control problems or fire, the Drillship Fire and Boat Station and Abandonment Procedure will be used.

For H<sub>2</sub>S evacuations, see Section B-6 of the Appendix.

**XIV. RESPONSIBILITIES AND DUTIES – H<sub>2</sub>S****A. All Personnel**

1. It is the responsibility of all personnel on the drillship, as well as any other personnel assisting in the drilling or abandonment of the well, to familiarize themselves with the procedures outlined in the “H<sub>2</sub>S Contingency Plan”.
2. Each individual is responsible for seeing that his assigned safety equipment is properly stored, easily accessible and routinely maintained.

3. Each person must familiarize himself with the location of safety equipment aboard the drillship and be able to use all safety equipment at a moment's notice. The location of all safety equipment is given in [Section C-1](#) of the Appendix.
4. All personnel must read the Contingency Plan and sign the "[Contingency Plan Memorandum of Understanding](#)".
5. Report any indications of H<sub>2</sub>S to those in the area first, then to VESSEL MASTER, Drilling Superintendent and/or to The Shell Drilling Foreman.

**B. Shell Drilling Foreman**

1. The Shell Drilling Foreman is responsible for thoroughly understanding and enforcing all aspects of the "H<sub>2</sub>S Contingency Plan".
2. The Shell Drilling Foreman is responsible for seeing that all safety and emergency procedures outlined in the "H<sub>2</sub>S Contingency Plan" are observed by all personnel participating in the drilling of the well.
3. The Shell Drilling Foreman will advise The Shell Drilling Superintendent and the Shell SIMOPS Coordinator whenever the procedures, as specified herein, cannot be complied with.
4. The Shell Drilling Foreman is responsible for equipment installation on the drillship prior to spudding a potential sour gas well as described under [Section V](#) "Safety Equipment".
5. The Shell Drilling Foreman in conjunction with the Noble Drilling Superintendent is responsible for scheduling training for all Shell, contractor and Noble personnel assigned to the drillship.
6. If the presence of H<sub>2</sub>S is reported and confirmed, The Shell Drilling Foreman is responsible for immediately advising the Emergency Room, the Vessel Master, the SIMOPS Supervisor, and the Drilling Superintendent.
7. The Shell Drilling Foreman shall restrict the number of personnel on the drillship to a minimum during expected hazardous operations.

**C. Vessel Master / Noble Drilling Superintendent**

1. The Vessel Master and/or Drilling Superintendent are responsible for thoroughly understanding the contents of the "H<sub>2</sub>S Contingency Plan". In the absence or incapacitation of the Vessel Master, or

Noble Drilling Superintendent. The Toolpusher will assume responsibilities designated herein.

2. It is the responsibility of the Vessel Master and/or Drilling Superintendent to see that all safety and emergency procedures outlined in the "H<sub>2</sub>S Contingency Plan" are observed by all Noble drilling and marine personnel aboard the rig.
3. The Drilling Superintendent shares the responsibility with the Shell Drilling Foreman in scheduling training for personnel assigned to the drillship.
4. The Vessel Master and/or Noble Drilling Superintendent will be responsible for directing the shutting off the forced air circulating system and closing all hatches in the event that H<sub>2</sub>S is detected in the atmosphere at any time.
5. The Vessel Master and/or Noble Drilling Superintendent will be responsible for inspecting the drillship to make sure that all passageways remain unobstructed.
6. The Vessel master and/or Noble Drilling Superintendent is responsible for alerting all personnel during a Condition I, II, or III alert and for displaying warning signs and flags (if used) as outlined under [Section VII](#) "Operating Conditions – Classification".
7. The Vessel Master is responsible for choosing the drillship heading to provide the highest level of protection for all personnel in the event H<sub>2</sub>S is detected.

#### D. H<sub>2</sub>S Safety Technicians

1. There will be at least two (2) H<sub>2</sub>S Safety Technicians aboard the vessel at all times during compliance operations. One H<sub>2</sub>S Safety Technician will work the day shift and the other will work the night shift. Both will respond to drills or H<sub>2</sub>S release at any time.
2. Is responsible for performing a weekly inventory to assure that all safety equipment is being properly stored and maintained.
3. Is responsible for logging the arrival and departure of all personnel on the drillship, as per BOE requirement.
4. Is responsible for the H<sub>2</sub>S training, which includes the use, maintenance, and storage of the safety equipment.

5. Is responsible for issuing H<sub>2</sub>S safety equipment to arriving personnel on the rig and for collection of same for departing personnel.
  6. Is responsible for the maintenance and repairs of all H<sub>2</sub>S safety equipment.
  7. Is responsible for the required inspection and sanitizing of the H<sub>2</sub>S safety equipment.
  8. Is responsible for the maintenance of H<sub>2</sub>S Safety Training Class Attendance Records, and other record keeping required. He shall furnish the Shell Drilling Foreman a copy of all class attendance records.
  9. Will observe and assist during weekly H<sub>2</sub>S drills.
  10. Will test the H<sub>2</sub>S sensors daily for response. A copy of the results will be given to The Shell Drilling Foreman.
  11. Will calibrate the H<sub>2</sub>S sensors weekly. A copy of the results will be given to The Shell Drilling Foreman.
- E. Dispatcher/ Radio Operator
1. The Dispatcher is responsible for notifying all personnel in the area of the rig (including any workboats and/or helicopters) of a change in conditions. The Shell SIMOPS Coordinator shall also be notified.
- F. Noble Toolpusher/ Driller
1. The Toolpusher and Driller must be completely familiar with the steps each must take during a Condition I, II, or III Emergency as outlined under Section VIII "H<sub>2</sub>S Emergency Procedure".
  2. The Toolpusher and Driller must be completely familiar with their assigned duties during well control and lost circulation problems as outlined under [Section XI](#) "Well Control" and [Section XII](#) "Lost Circulation".
  3. In the absence or incapacitation of all Shell Drilling Foremen, the Vessel Master and Noble Drilling Superintendent then the Toolpusher will assume the lead role in H<sub>2</sub>S response as designated herein.

### G. Mudlogger

1. Is responsible for the switch inside the mudlogging unit that controls the forced air duct leading to the unit.
2. Is responsible for a multi-gas detector which will be kept in the mudlogging unit.

### H. Mud Engineer

1. Must have a Garret Gas Train Kit for measuring the sulfides in the mud if a water-based drilling fluid is used, and must be fully trained on its use.
2. Must be familiar with the “Mud Treating” procedure for H<sub>2</sub>S cut mud in [Section A-3](#) of the Appendix.
3. Is responsible for assuring that the rig has a sufficient supply of 100% zinc carbonate or an equivalent H<sub>2</sub>S scavenger.

### I. H<sub>2</sub>S Flaring

1. When flaring, hourly readings for SO<sub>2</sub> and H<sub>2</sub>S will be monitored with a fixed or portable instrument implementing the buddy system.
2. Detection of 5 ppm of SO<sub>2</sub>: Personal protective measures will be taken by personnel in work areas affected. Self contained breathing apparatus will be utilized to take hourly readings using the buddy system. All unnecessary personnel will be evacuated from the affected area and if necessary from the facility using only designated personnel to take corrective action. The designated personnel will be the same as listed for an H<sub>2</sub>S emergency response. Briefing areas will be utilized as necessary. H<sub>2</sub>S readings will be monitored and logged along with SO<sub>2</sub> readings.
3. Detection of 2 ppm of SO<sub>2</sub>: Personal protective measures will be taken by personnel in work areas. Self contained breathing apparatus will be utilized to take hourly readings using the buddy system. All unnecessary personnel will remain out of the affected area upwind. Quarters or briefing areas will be utilized as needed pertaining to emergency conditions as described in this plan for H<sub>2</sub>S and the concentration of SO<sub>2</sub>.



## XV. PROCEDURE FOR INFORMING PERSONNEL OF H<sub>2</sub>S CONTINGENCY PLAN

### A. Aboard Drillship

1. There will be a complete copy of this H<sub>2</sub>S Contingency Plan available in the **Shell Drilling Foreman's** office, **Vessel Master's** office, **Emergency Room**, **Radio Room** and the **Noble Drilling Superintendent's** office.
2. ALL Personnel arriving at the rig will report immediately to the H<sub>2</sub>S Safety Technician for familiarization with the Contingency Plan. Each person will be required to sign a log indicating that they have been briefed on, and do understand, this H<sub>2</sub>S Contingency Plan.
3. The H<sub>2</sub>S Safety Technician will train the crews and familiarize them with the "[Contingency Plan Memorandum of Understanding](#)". Written records will be maintained.

### B. Aboard Support Vessels

A copy of this H<sub>2</sub>S Contingency Plan will be given to the Master of each of the support vessels. They will be required to sign a log indicating that they have read and understand the plan.

## XVI. SEARCH & RESCUE TEAMS

### A. Primary Goal

Rescue team members must realize that the primary goal of the team should be to inspect all areas of the drillship for personnel who have been overcome by H<sub>2</sub>S or SO<sub>2</sub>. However, from a practical stand point, the potential for someone to be overcome is greatest during a Condition III release as indicated by the Flashing BLUE & RED lights and siren, it is essential that the Rescue Teams report to the staging area & report in with their assigned SCBA units and then immediately begin a search of the below deck areas.

### B. Critical Areas

During drilling or P&A activities, the four most critical areas can be defined as the shale shaker area, mud pit area, possum belly and drill floor area. The trip tank area is also critical when tripping pipe. Accordingly, the H<sub>2</sub>S Emergency Station Bill is designed to ensure that such areas are quickly evaluated after and/or during any significant H<sub>2</sub>S release. For example, the H<sub>2</sub>S Technicians during such times ensure that the shaker area and trip tank will be checked, while the Toolpusher and Noble Drilling

Superintendent ensure the drill floor is checked. In addition, the Rescue Team ensures that all below deck water-tight doors will be secured to prevent migration of gas.

C. Unconscious Victims

Rescue Team members must realize that in the event an unconscious victim is found, it may or may not be necessary to move the victim before administering the necessary first-aid. The determining factor will be the presence of H<sub>2</sub>S or some other threat which poses an immediate danger to victim as well as the rescue personnel. Since procedures call for the mud pumps to be shut down if H<sub>2</sub>S is detected, it is unlikely that large volumes of H<sub>2</sub>S will continue to be released.

D. Purging the Area

This coupled with the ventilation systems presently on the drillship, enhance the possibility that any H<sub>2</sub>S or other gas will be quickly purged from an area, such as the pit area. Persons found unconscious may have tripped or fallen when responding to the H<sub>2</sub>S alarms, and as a result may have suffered neck or spinal injuries. In such a case, moving the victim could prove fatal. Therefore, it is essential that the Rescue Team properly determine not only the victim condition, but also the condition of the surrounding area.

E. Procedures and Drills

1. **CONDITION I**

a. ON-DUTY TEAMS: IN THE EVENT OF CONDITION I OR II

- 1) Proceed to staging area and report in, then don 30 minute SCBA. Do not open cylinder valve or don facepiece.
- 2) Check portable H<sub>2</sub>S detectors and Clear-Com Devices

2. **CONDITION II or III**

a. ON-DUTY TEAMS: IN EVENT OF AN H<sub>2</sub>S RELEASE

- 1) Proceed to staging area and report in, then don assigned RESCUE TEAM SCBA.
  - a. Check portable H<sub>2</sub>S detectors and Clear-Com devices.
  - b. In the event a team member(s) is missing, proceed as a group of 3 or 2. Do not proceed alone.
- 2) Proceed in teams down to designated start point.
  - a. Secure watertight doors and hatches along way to prevent migration of H<sub>2</sub>S.

- 3) Team 1 – Follow normal rescue team procedures as outlined in the Station Bill.

Team 2 – Follow normal rescue team procedures as outlined in the Station Bill.

- a. Continue to secure all watertight doors and hatches to prevent gas migration.

- 4) In the event you encounter a person(s) in distress:

- a. One team member checks to see if victim is breathing while other team member checks for H<sub>2</sub>S in area.

- If victim is breathing and no contamination is present, alert the Medical staff in the infirmary. Continue to monitor area with H<sub>2</sub>S Detectors.
- If victim is breathing and/or contamination is present, remove victim to safe area immediately and then notify the Medical staff.

- b. Verify area is safe from H<sub>2</sub>S with portable detector, before removing mask.

- c. Check victim again for breathing and pulse (heartbeat).

- d. Administer mouth-to-mouth resuscitation if victim is not breathing or CPR if victim has no heart beat.

- e. Alert the Medical staff immediately. Do not leave anyone in distress unattended.

- f. Obtain oxygen resuscitator and stretcher. Typically, this equipment will be brought to scene by Medical staff..

- Replace mouth-to-mouth activities with the mechanical resuscitator.
- Transfer patient(s) to Safe Briefing Area or Infirmary as quickly as possible for further treatment.

**NOTE:** When transferring a patient, every effort must be made to use a route that has been verified to be gas free. If a breathing patient must be transferred through an area that could potentially be contaminated, it will be necessary to supply a safe source of breathing air to the patient.

- 5) Rescue Teams should meet in the Staging Area or designated Safe Briefing Area after completing their respective search activities.

- a. If only one team has conducted the search, then proceed from the staging to the Designated Safe Briefing Area.

- b. Report to supervisory personnel and be prepared to conduct additional search, rescue and/or hazard assessment activities as needed.
  - c. Check SCBA cylinder to ensure it contains a minimum of 1500 psi; recharge or replace the cylinder if necessary.
- a. OFF-DUTY RESCUE TEAM: IN THE EVENT OF AN H<sub>2</sub>S RELEASE
- 1) Be prepared to assist as needed.

## **APPENDIX**

## APPENDIX – SECTION A PROCEDURES

### SECTION A-1

#### ***WELL CONTROL PROCEDURES***

All efforts should be made to prevent a well kick, which may result from gas cut mud, abnormal pressure, and loss in circulation, or swabbing. Should any of the following conditions occur, the well should be checked for flow.

1. Increase in flow across the shale shaker.
2. Gain in pit volume.
3. Hole does not take correct fill on trips.
4. Significant drilling break.
5. Decrease in pump pressure.
6. Significant increase in connection gas.

If well flow is confirmed, the following actions will be taken:

#### Shut-In Procedure While Drilling

1. Sound kick alarm
2. Pick up to space out position and break off top drive or false kelly
3. Install stab-in safety valve (TIW Valve) in top of drill string and close
4. Close BOP and make certain well is shut-in
5. Re-install top drive or false kelly and open TIW valve
6. Read and record:
  - a. Shut-in drillpipe pressure, if any
  - b. Shut-in casing pressure
  - c. Mud volume gained.

#### Shut-in Procedure While Tripping or Running Casing

1. Sound kick alarm
2. Pick up to space out position
3. Install crossover and TIW valve in top of drill string or casing and close
4. Close BOP and check to see that well is shut-in
5. Make up top drive or false kelly onto drill string or casing and open TIW valve
6. Read and Record:

- a. Shut-in drillpipe or casing pressure, if any
- b. Shut-in annulus pressure
- c. Mud volume gained.

#### Shut-in Procedure With Pipe out of the Hole

1. Close well in with blind/shear rams and check to see that it is shut-in
2. Close hydraulic choke and open choke line
3. Read and record:
  - a. Shut-in well pressure
  - b. Mud volume gained

The handling of the H<sub>2</sub>S kick will normally involve one of the two following techniques:

- Pumping the kick away
- Circulating the kick out

The technique selected must be based on the conditions existing at the time of the occurrence. The selected technique will have as its objective the protection of human life, protection of the environment, and protection of property respectively.

As long as it is operationally feasible and safe to do so, all kicks (especially H<sub>2</sub>S kicks) will preferentially be bullheaded away rather than circulated out. This plan of action has the advantage of minimizing the surface risk to personnel, environment, and service equipment.

In some cases, it will be necessary to set a barite or cement plug over the H<sub>2</sub>S-bearing formation to accomplish proper well control. If drilling cannot safely proceed the well may be permanently abandoned.

If the decision is made to circulate out the H<sub>2</sub>S kick, operations should not be initiated until briefings have been held with all personnel involved, equipment is made ready and alert/warning signs are displayed.

Regardless of which technique is employed to deal with an H<sub>2</sub>S kick, all personnel on the rig floor and mud circulating areas should secure SCBAs and ensure that they are "at ready" should donning become necessary.

## SECTION A-2

### **LOST CIRCULATION PROCEDURE**

If lost circulation is experienced during any phase of the drilling operations, every effort will be made to fill the hole and keep it full. The driller should:

1. Pick up to space out position and shut down the mud pumps
2. Notify the Toolpusher and Shell Drilling Foreman as soon as practical
3. Fill trip tank with fluid (seawater, drilling water or drilling fluid may be used). Consideration should be given to keeping one side of the trip tank filled with a lower weight fluid during drilling operations
4. Begin filling hole from the trip tank. If hole will not fill from the trip tank, begin pumping fluid into the annulus keeping track of all fluid volumes pumped  
**NOTE:** Pumping excessive volumes of light weight fluid has the risk of reducing hydrostatic pressure in the wellbore and inducing the well to flow.
5. Work the drill string while attempting to fill and regain circulation to avoid differential sticking
6. When hole fills, determine and record the volume of water required to fill the hole.
  - a. Check well for flow. If well is static and hole stands full, monitor for possible flow. Keep trip tank on the hole.
  - b. If well is flowing, shut well in per "Well Control Procedure"
7. Procedure(s) to regain circulation will be developed based on hole conditions. **DO NOT PULL INTO CASING** until approved by the Shell Drilling Foreman. One or more of the following methods will be used:
  - a. Introducing lost circulation materials into the mud system and/or minimizing mud weight
  - b. Spotting lost circulation pills over the suspected thief zone
  - c. Bullheading cement or other sealing fluid into the thief zone
  - d. Pulling up into the casing to allow the hole to heal
  - e. If the loss circulation problem is severe, consideration will be given to setting an additional casing string through the thief zone and cementing it in place



## SECTION A-3

### **MUD TREATING**

1. Zinc oxide, or an equivalent H<sub>2</sub>S scavenger, will be used to treat out H<sub>2</sub>S in the mud system. It should not be added to the system until soluble sulfides are detected in the mud by the Mud Engineer and approval is given by the Shell Drilling Foreman
2. After H<sub>2</sub>S is detected, the initial treatment of the H<sub>2</sub>S scavenger should be sufficient to treat the soluble sulfides only to a zero concentration. Treatment in excess is to be avoided.
3. The mud system must be maintained with a pH greater than 10.0. The pH of the mud system will be maintained by adding lime or caustic soda or equivalent and the high pH should be maintained below compliance depth. A rapid decrease in pH is a possible indication of the presence of H<sub>2</sub>S in the mud system.
4. The mud system could contain H<sub>2</sub>S and/or sulfides if agitation is not adequate to remove all of it.
5. The Mud Engineer will have a Garrett-Gas-Train test kit aboard the vessel readily available to conduct a test for soluble sulfides that will confirm the presence and approximate amount of H<sub>2</sub>S in the mud.
6. From compliance depth to total depth, the Mud Engineer will test for sulfides at least every 12 hours using Garrett-Gas-Train test kit. Detailed instruction for performing these tests will be maintained on the rig (API RP 13B).
7. The results of these checks or any other indication of H<sub>2</sub>S in the mud system will be included as a routine part of the mud engineer's daily reports.
8. Pilot tests on mud samples will be performed to determine, in advance, the effects of ½ and 1 lb/bbl concentrations of the H<sub>2</sub>S scavenger on the rheological properties of the mud system.

#### **Mud Treatment Plan Specific to an H<sub>2</sub>S Occurrence**

##### Pre-Planning

1. At least one complete Garrett Gas Train and required supplies must be available on the drillship before drilling commences on any Chukchi Sea exploration well. Because of the distance from sources of supply and logistical considerations, two complete Garrett Gas Trains should be available on the rig.

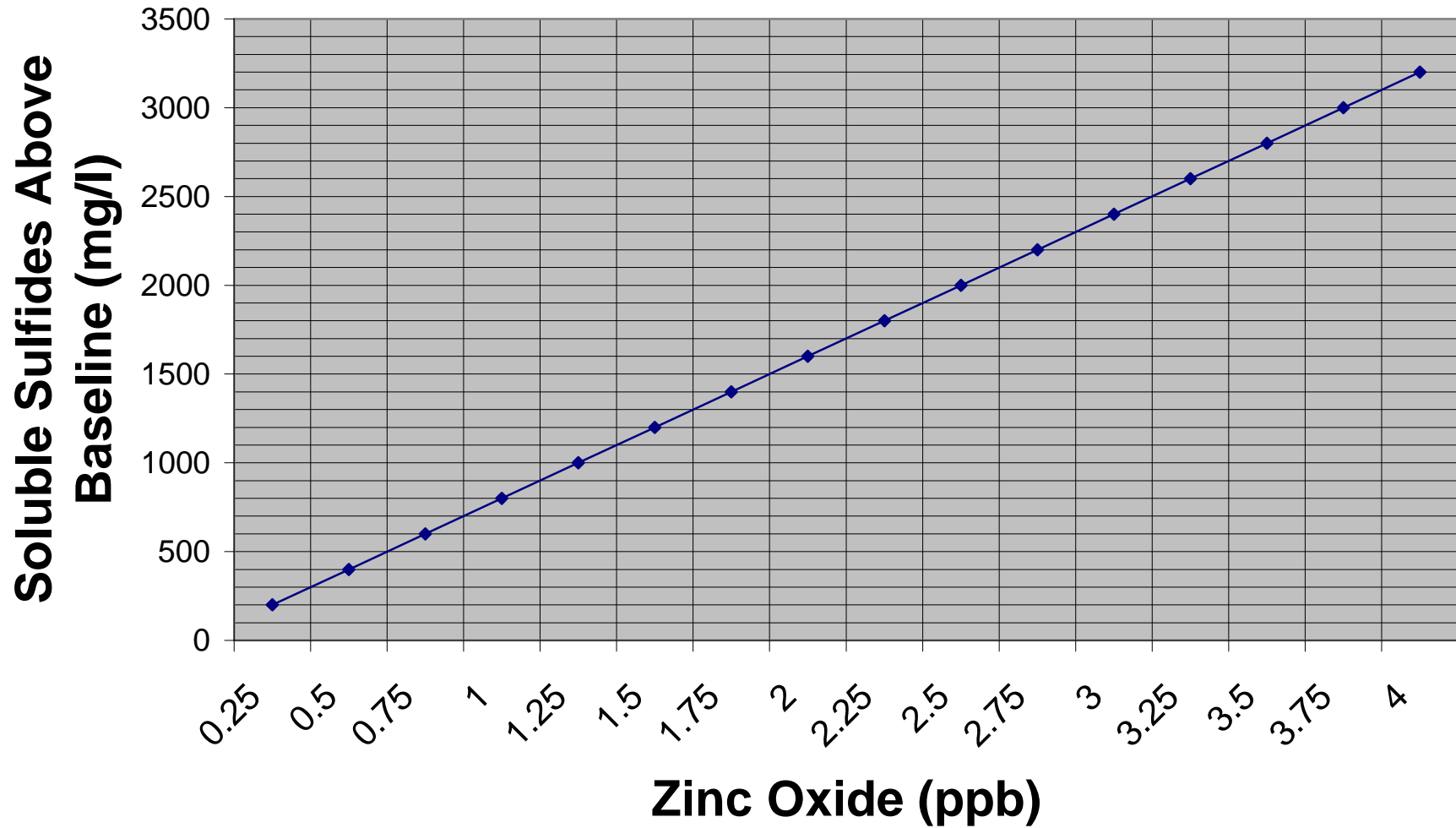
2. A baseline sulfide level in the circulating system will be established well in advance to entering potential H<sub>2</sub>S zone.
3. Adequate scavengers (zinc oxide or equivalent) will be on board prior to entering potential H<sub>2</sub>S zone. Enough zinc oxide or other scavenger will be on board to add twice the amount necessary to remove all H<sub>2</sub>S to the entire circulating system (e.g., two complete treatments of zinc carbonate at 2 ppb).
4. The PSM (POM) in the circulating system should be ≥ 5 mL prior to entering potential H<sub>2</sub>S zone.
5. The electrical stability will be increased to as high as practical prior to entering potential H<sub>2</sub>S zone (>500 mV ES is sufficient).

### Treatments and Procedures

1. Maintain PSM in the suction ≥ 5 mL.
2. If the PSM at the flow line is depleted to <3 mL, the suction PSM should be increased to commensurate with the depletion rate.
3. Zinc oxide should not be added to the system unless soluble sulfides (greater than the established base line) are detected in the mud system by the Mud Engineer and approval is given by the Shell Drilling Foreman.
4. If an H<sub>2</sub>S increase is seen to 200 mg/L above the baseline through the Garret Gas Train, ¼ ppb zinc oxide should be added to the mud system.
5. If an increase of 200 mg/l to 400 mg/l above the baseline is observed, ½ ppb zinc oxide should be added to the system.
6. If an increase of 400 mg/l to 600 mg/l is noticed, ¾ ppb zinc oxide should be added.
7. If an increase of 600 mg/l to 800 mg/l is noticed 1 ppb zinc oxide should be added.
8. These treatments are based on the assumption that 1 ppb zinc oxide will treat out 800 mg/l to 1,200 mg/l H<sub>2</sub>S in the drilling fluid. .
9. The objective will be to maintain the sulfide level at the baseline. Anything above the baseline will have the potential for embrittlement and/or corrosion of the drill string and other critical rig components to occur.
10. The Garret Gas Train test will be run a minimum of once every 12 hrs. (or as hole conditions dictate). It is very important to adjust the baseline to set a target for follow-up treatment it in the event that H<sub>2</sub>S is encountered as drilling progresses.
11. Pilot testing with zinc oxide should be done to ensure that effective treatments are being made to the system to minimize any H<sub>2</sub>S picked up while drilling.
12. In the event of a temporary abandonment or suspension 2 ppb zinc oxide will be added to the drilling fluid left in the hole.

Note: The objective is to treat all active sulfides in the mud system with zinc oxide to form ZnS (zinc sulfide) which is a very stable compound in a reaction that is essentially non-reversible. However, caution should be exercised to match treatments to active sulfides above the baseline so as to minimize potential toxic impacts.

# Zinc Oxide Treatment



## APPENDIX-SECTION B GENERAL INFORMATION

### SECTION B-1

#### **TOXICITY OF VARIOUS GASES**

Common Name	Chemical Formula	Specific Gravity <sup>1</sup>	PEL (OSHA) <sup>2</sup>	STEL <sup>3</sup>	Lethal <sup>4</sup> Limit, ppm
Hydrogen Cyanide	HCN	0.94	10	150	300
Hydrogen Sulfide	H <sub>2</sub> S	1.18	10	15	600
Sulfur Dioxide	SO <sub>2</sub>	2.21	2	5	1000
Chlorine	Cl <sub>2</sub>	2.45	1		
Carbon Monoxide	CO	0.97	35	200/1 hour	1000
Carbon Dioxide	CO <sub>2</sub>	1.52	5000	5%	10%
Methane	CH <sub>4</sub>	0.55	90000 (9%)	Combustible (Above 5 % in air)	

<sup>1</sup> Air=1.0

<sup>2</sup> Permissible - Concentration at which is believed that all workers may repeatedly be exposed, day after day, without adverse effect.

<sup>3</sup> STEL - Short Term Exposure Limit.

<sup>4</sup> Lethal - Concentration that will cause death with short-term exposure.

### **PROPERTIES OF GASES**

#### A. CARBON DIOXIDE

- Carbon Dioxide is usually considered chemically inert although it is both a suffocant and toxic to humans in high concentrations. It is 1.52 times heavier than air and will concentrate in low areas of still air. Humans cannot breathe air containing more than 10% CO<sub>2</sub> without losing consciousness. Air containing 5% CO<sub>2</sub> will cause disorientation in a few minutes. Continued exposure to CO<sub>2</sub> after being affected will cause convulsions, coma, and respiratory failure.
- The PEL-TWA<sub>8</sub> of CO<sub>2</sub> is 5000 ppm. STEL (15 min) to CO<sub>2</sub> is 50,000 ppm (5%).

3. This gas is colorless, odorless, and can be tolerated for short time periods in relatively high concentrations. In higher concentrations, short term exposure can result in suffocation due to displacement of oxygen from the environment. Continued exposure can result in a blood pH drop with subsequent toxic impacts.

#### B. HYDROGEN SULFIDE

1. Hydrogen Sulfide (H<sub>2</sub>S) is a colorless, transparent, flammable gas. It is heavier than air and, hence, may accumulate in low places.
2. Although the slightest presence of H<sub>2</sub>S in the air is normally detectable by its characteristic “rotten egg” odor, it is dangerous to rely on the odor as a means of detecting excessive concentrations because the sense of smell is rapidly lost, allowing lethal concentrations to be accumulated without warning. The following table indicates the poisonous nature of H<sub>2</sub>S.

CONCENTRATION in AIR			EFFECTS
% H <sub>2</sub> S	ppm	gr/100 SCF <sup>1</sup>	
0.001	10	0.65	Safe for 8 hours without respirator. Obvious and unpleasant odor.
0.0015	15	0.975	Safe for 15 minutes of exposure without respirator.
0.01	100	6.48	Kills smell in 3-15 minutes; may sting eyes and throat IDLH
0.02	200	12.96	Kills smell quickly; stings eyes and throat.
0.05	500	32.96	Dizziness; breathing ceases in a few minutes; need prompt artificial respiration.
0.07	700	45.92	Rapid Unconsciousness; death will result if not rescued promptly.
0.1	1000	64.80	Instant unconsciousness, followed by death within minutes.

<sup>1</sup> Grains per 100 Standard Cubic Feet

#### Treatment Procedures for Hydrogen Sulfide Poisoning

- A. Remove the victim to fresh air.
- B. If breathing has ceased or is labored, begin resuscitation immediately.  
**NOTE:** This is the quickest and preferred method of clearing victim’s lungs of contaminated air; however, under disaster conditions, it may not be practical to move the victim to fresh air. In such instances, where those rendering first aid must continue to wear masks, a resuscitator should be used.
- C. Apply oxygen resuscitator to help purge H<sub>2</sub>S from the blood stream.
- D. Keep the victim at rest and prevent chilling.
- E. Get victim under physician’s care as soon as possible.

### C. SULFUR DIOXIDE

1. Sulfur Dioxide (SO<sub>2</sub>) is a colorless, non-flammable, transparent gas.
2. SO<sub>2</sub> is commonly produced during the burning of H<sub>2</sub>S. Although SO<sub>2</sub> is heavier than air, it can be picked up by a breeze and carried downwind at elevated temperatures. Since SO<sub>2</sub> is extremely irritating to the eyes and mucous membranes of the upper respiratory tract, it has exceptionally good warning powers in this respect. The following table indicates the toxic nature of SO<sub>2</sub>.

#### SO<sub>2</sub> Effects

CONCENTRATION in AIR		EFFECTS
% SO <sub>2</sub>	PPM	
0.003 – 0.005	3 to 5	Pungent odor, normally a person can detect SO <sub>2</sub> in this range.
0.012	12	Throat irritation, coughing, constriction of the chest, tearing and smarting of eyes.
0.15	150	So irritating that it can only be endured for a few minutes.
0.05	500	Causes a sense of suffocation, event with the first breath.
0.10	1000	Death may result unless rescued promptly.

3. If gas containing H<sub>2</sub>S is burned, the following steps must be taken to protect against SO<sub>2</sub>.
  - a. Monitor the SO<sub>2</sub> concentration in the air with portable or strategically placed fixed devices capable of detecting a minimum of 2 ppm or SO<sub>2</sub>;
  - b. Take readings at least hourly and at any time personnel detect SO<sub>2</sub> odor or nasal irritation;
  - c. Implement the personnel protective measures specified in the H<sub>2</sub>S Contingency Plan if the SO<sub>2</sub> concentration in the work area reaches 2 ppm; and
  - d. Calibrate devices every 3 months if you use fixed or portable electronic sensing devices to detect SO<sub>2</sub>.

**SECTION B-1**

**H<sub>2</sub>S CONTINGENCY PLAN MEMORANDUM OF UNDERSTANDING**

Signature Form:

Company: \_\_\_\_\_

Well: \_\_\_\_\_

I, \_\_\_\_\_, an employee of \_\_\_\_\_, have been briefed on the H<sub>2</sub>S contingency plan and understand it.

\_\_\_\_\_  
Signature \_\_\_\_\_ Date

NOTE: This signed form will be kept on file on the drillship.

## SECTION B-2

### BREATHING AIR EQUIPMENT DRILLS FOR ON-DUTY PERSONNEL

On-duty personnel include Drilling, Marine and Roustabout Crew, Vessel Master, Noble Drilling Superintendent, H<sub>2</sub>S Safety Technician, the Shell Drilling Foreman and all other personnel on tour including contractors and catering personnel..

The Mudlogger and Mud Engineer will report to the Muster Area, and then take directions from the PIC.

An H<sub>2</sub>S drill and training session will be conducted weekly.

The purpose of this drill is to instruct the crews in the operation and use of breathing air and H<sub>2</sub>S related emergency equipment and to allow the personnel to become acquainted with using the equipment under working conditions. The crews should be trained to put on the breathing air equipment within one minute after an H<sub>2</sub>S emergency has been alerted.

The following procedure should be used for weekly drills. The Shell Drilling Foreman, VESSEL MASTER, and Drilling Superintendent must be satisfied that the crews are proficient with the equipment.

NOTE: The drill will be conducted as outlined under “Emergency Procedures for Condition II and Condition III”

1. All on-duty personnel should be informed that a drill will be held.
2. The H<sub>2</sub>S Safety Technician should initiate the drill by signaling as he would if he detected H<sub>2</sub>S.
3. The driller should shut down the mud pumps, pick up to space out position and continue to rotate the drillpipe while he and the drilling crew don their breathing air equipment. The Mudlogger, Mud Engineer, Toolpusher, Noble Drilling Superintendent, and affected Shell personnel should also don their breathing air equipment.
4. The driller will proceed as if the well is flowing; simulate closing the well in, but DO NOT ACTUALLY CLOSE THE BOP without orders from the Toolpusher.
5. After reporting to the Muster station, The Mud Engineer will be directed to perform a flowline check for mud weight and funnel viscosity, and catch a mud sample for the sulfides test on the mud. This part of the drill is important, as Shell wants to make it a standard practice that a sulfides test be run every time



anything unusual happens. In a DRILL ONLY, it may not be necessary to perform the sulfides test on the mud.

6. During the Drill, the Shell Drilling Foreman, Vessel Master, Noble Drilling Superintendent, and the H<sub>2</sub>S Safety Technician will observe to make sure that everyone is using their equipment properly.
7. Resume normal operations.
8. The Vessel Master, Noble Drilling Superintendent, Shell Drilling Foreman, and the H<sub>2</sub>S Safety Technician will hold a review to discuss results of the drill with those participating.
9. H<sub>2</sub>S drill performance, new H<sub>2</sub>S considerations at the facility, and other updated H<sub>2</sub>S information should be discussed at a safety meeting at least monthly.

## SECTION B-3

### BREATHING AIR EQUIPMENT DRILLS AND TRAINING SESSIONS FOR OFF-DUTY PERSONNEL

Off-duty personnel include all personnel aboard the drillship with the exception of the On-Duty Drilling, Marine and Roustabout Crew, Mudlogger, Mud Engineer, Noble Drilling Superintendent, H<sub>2</sub>S Safety Technician, and Shell Drilling Foreman.

An H<sub>2</sub>S drill and training session will be conducted weekly for all off-duty personnel to simulate steps that must be taken by personnel who are on their time off when an H<sub>2</sub>S alarm is activated.

This training will be conducted to instruct personnel in the operation and use of self-contained breathing apparatus and H<sub>2</sub>S related emergency equipment, and to review various operating procedures in the "H<sub>2</sub>S Contingency Plan".

Initial Drills should include:

1. General information about the self-contained breathing apparatus (SCBA), including air supply time limit, connection to breathing air manifold(s), and proper packing and storage. Spectacle Kits for SCBAs should be utilized in place of contact lenses or spectacles.
2. How to put the mask on and test for leaks around face and hose connections. All personnel will be informed of the restrictions against having beards.

These drills should be conducted as often as necessary to acquaint the crews with the equipment. After the Shell Drilling Foreman, Vessel Master and/or Drilling Superintendent are convinced that all personnel are trained, a weekly drill must be conducted. This drill may be initiated any time. Prior to the drill, the Drill and Marine crew on duty must be informed that it is only a practice drill. This drill will be initiated by the Condition II or Condition III general alarm signal given by the Vessel Master, Drilling Superintendent or the Shell Drilling Foreman. At this time, all off-duty personnel will immediately get their assigned SCBAs and Type I Life Jackets and report to the "MUSTER AREA". Personnel should be trained to report to the "MUSTER AREA", then to "SAFE BRIEFING AREA" with their emergency equipment within three minutes after the alarm has sounded. A training and information session will be conducted after each drill to answer any H<sub>2</sub>S related questions and to cover one or more of the following:

- Condition I or II alerts and steps to be taken by all personnel.
- The importance of wind direction when dealing with H<sub>2</sub>S.
- Proper use and storage of all types of breathing equipment.
- Proper use and storage of oxygen resuscitators.
- The "buddy system" and the procedure for rescuing a person overcome by H<sub>2</sub>S.
- Responsibilities and duties.
- Location of H<sub>2</sub>S safety equipment.

- Other parts of the “H<sub>2</sub>S Contingency Plan” that should be reviewed.

NOTE: A record of attendance must be kept for weekly drills and training session. These drills must also be documented on the IADC Report and the Shell Daily Drilling Report.

## SECTION B-4

### HYDROGEN SULFIDE TRAINING CURRICULUM

At the docks and on the rig; each individual will be asked if they have been cleared by a physician to use a respirator. This requirement will be the responsibility of each company or individual before coming aboard the rig.

Each person will be informed on the restrictions of having beards and contact lenses. They will also be informed of the availability of spectacle kits. Personnel with beards or moustaches that extend past the corners of the mouth must shave and continuously restrict the regrowth of facial hair while drilling operations are in progress. Both Noble and Shell HSSE representatives will monitor personnel to ensure that the restriction on facial hair is enforced. This restriction applies to all personnel aboard the vessel including visitors.

The safety program is outlined in the H<sub>2</sub>S Contingency Plan. This plan will be available on the rig. Each individual will read and sign "Considerations during the Drilling or Abandonment of a sour gas well."

After the H<sub>2</sub>S equipment is rigged up, all personnel will be H<sub>2</sub>S trained and put through a drill. Any deficiencies will be corrected.

Training Completion cards are good for one year and will indicate date of completion or expiration. Personnel previously trained on another facility and visiting the drillship must attend a "supplemental briefing" on H<sub>2</sub>S equipment and procedures before beginning duty. Visitors without current H<sub>2</sub>S certification who remain on the facility more than 24 hours must receive full H<sub>2</sub>S training given all crew members. A "supplemental briefing" will include but not be limited to: location, use and donning of an assigned respirator, familiarization with safe briefing areas, alarms with instruction on responsibilities in the event of a release and hazards of H<sub>2</sub>S and SO<sub>2</sub>.

Topics for full H<sub>2</sub>S training shall include, but not limited to the following:

- I. Brief Introduction on H<sub>2</sub>S
  - A. Slide or VCR Presentation (If available)
  - B. H<sub>2</sub>S Material will be distributed
  - C. Re-emphasize the properties, toxicity, and hazards of H<sub>2</sub>S.
  - D. Source of SO<sub>2</sub>.
  
- II. H<sub>2</sub>S Detection
  - A. Description of H<sub>2</sub>S sensors
  - B. Description of warning system (how it works and its location)
  - C. Actual location of H<sub>2</sub>S sensors
  - D. Instruction on use of pump type detector
  - E. Use of card detectors, ampoules, or dosimeters
  - F. Use of combustible gas detector

- G. Other personnel detectors used
- H. Alarm conditions I or II (10 ppm, 20 ppm)

### III. H<sub>2</sub>S Protection

- A. Types of breathing apparatus provided (30 minute SCBA & Work Units with voice diaphragms for communication)
- B. Principle of how breathing apparatus works.
- C. Demonstration on how to use breathing apparatus.
- D. Location of breathing apparatus.

### IV. Cascade System

- A. Description of Cascade system
- B. How System works
- C. Location of cascade with reference to briefing areas.
- D. How to use cascade system with recharge/refill of SCBA
- E. Importance of wind direction and actual location of windsocks
- F. Purpose of compressor/function

### V. H<sub>2</sub>S Rescue and First Aid

- A. Importance of wind direction
- B. Safe briefing area
- C. Buddy System
- D. H<sub>2</sub>S Symptoms
- E. Methods of rescue

### VI. Hands on Training

- A. Donning/familiarization of SCBA
- B. Donning/familiarization of other breathing apparatus/ work units
- C. Familiarization of cascades
- D. Use of O<sub>2</sub> resuscitator
- E. Alarm conditions – upwind briefing areas, etc.
- F. Duties and responsibilities of all personnel
- G. Procedures for evacuation
- H. Search and Rescue teams

### VII. Certification

- A. Testing on material covered.

**NOTE: TRAINING AND DRILLS WILL INVOLVE SUPPORT VESSELS TO THE EXTENT FEASIBLE AND PRUDENT, AS DETERMINED BY THE VESSEL MASTER AND SHELL DRILLING FOREMAN.**



STANDARD FIT TEST FORM

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_  
 ID NUMBER / SSN: \_\_\_\_\_  
 COMPANY: \_\_\_\_\_  
 LOCATION: \_\_\_\_\_  
 MASK TYPE: \_\_\_\_\_ SIZE: \_\_\_\_\_

<input type="checkbox"/> QUALIATIVE FIT TEST:		<input type="checkbox"/> QUANTATATIVE FIT TEST:	
TEST NUMBER	FIT FACTOR		P/F
Test #1 Normal Breathing			
Test #2 Deep Breathing			
Test #3 Head Side to Side			
Test #4 Head Up & Down			
Test #5 Talking			
Test #6 Bend and Touch Toes			
Test #7 Normal Breathing			

OVERALL FIT FACTOR	OVERALL PASS / FAIL

\_\_\_\_\_  
 Person Conducting Test Date

\_\_\_\_\_  
 Person Taking Test Date



Technical Division

TRAINING ROSTER FORM

Company:	Location:	Lease: Chukchi Sea	Date:
Drillship: <i>Noble Discoverer</i>		Instructor:	
Topics Discussed:			
Equipment Discussed:			
Equipment Demonstrated:			
Film Shown:		Job Number:	

No.	NAME (Print)	S.S. #	Company	Signature	Date
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

## SECTION B-5 EMERGENCY TELEPHONE LISTING

### **SHELL GULF OF MEXICO INC.**

A. Initial detection, but less than 10 ppm – Notify the Anchorage Office or residence of one of the following:

Shell Drilling Superintendent	TBD
Shell Drilling Engineer	TBD
Shell SIMOPS Coordinator	TBD
Shell HSSE Advisor	TBD

Alaska Emergency and Incident Reporting Number:	877-273-2443
(Operated by Purcell Security)	907-264-7777

B. Moderate danger – 20 ppm – Notify Anchorage Office or one of above at residence. Division office will notify the appropriate authorities. The M.M.S. and Coast Guard must be notified.

### **DRILLING CONTRACTOR**

Noble Rig Manager	TBD
Noble Anchorage Office	TBD
Noble Houston Office	TBD

### **AREA HOSPITAL FACILITIES**

Providence Alaska Medical 3200 Providence Dr. Anchorage, AK 99508	Main Line: 907-562-2211 Emergency Room: 907-261-3111
---	---

Alaska Native Medical Center 4315 Diplomacy Dr. Anchorage, AK 99508	Main Line: 907-729-1729
---	-------------------------

Alaska Regional Medical Center 2801 DeBarr Rd. Anchorage, AK 99508	Main Line: 907-276-1131 Emergency Room: 907-264-1232
--	---



**SHELL MEDICAL COORDINATOR**

Beacon Medical  
800 Cordova St.  
Anchorage, AK 99501

907-222-7612  
907-222-6976 fax

**DEPARTMENT OF THE INTERIOR**

US BOEMRE – Alaska District

Main Number: 907-334-5200  
Fax: 907-334-2502  
Toll Free: 800-764-2627  
Office: 907-334-5200  
Office: 907-334-5300  
Fax: 907-334-5302

Regional Director – Jim Kendall  
Regional Supervisor/Field Operations

After Hours:

Jeff Walker  
Kyle Monkeliem  
Randy Howell

907-250-0546  
907-351-2402  
907-382-7814

**UNITED STATES COAST GUARD**

National Response Center  
Washington, D.C.  
USCG-Alaska

Office: 800-424-8802  
Office: 202-267-2675  
Office: 907-463-2065  
Fax: 907-463-2820  
Toll Free: 800-424-8802  
Office: 907-487-5889

US Coast Guard Station

**ENVIRONMENTAL PROTECTION AGENCY**

Region 10, Anchorage, Alaska Office  
222 W. 7<sup>th</sup> Avenue  
Suite 19  
Anchorage, AK 99513

Office: 907-271-5083  
Fax: 907-271-3424  
Toll Free: 800-781-0983

## SECTION B-6

### KEY PERSONNEL TO REMAIN ABOARD DURING PARTIAL EVACUATION

Evacuation of personnel from the *Discoverer* to the evacuation/standby vessel will be conducted using the personnel basket and crane.

This is a suggested list of minimum personnel to remain on location; however, wellsite conditions may dictate that an alternative list be followed.

<b>Qty.</b>	<b>Position</b>
1	Vessel Master
2	Shell Drilling Foreman
1	Maintenance Supervisor
1	Electrical Supervisor
1	Mechanical Supervisor
1	Electronics Technician
1	Motorman
1	Medic (SAFETY TECH)
1	Subsea Engineer
2	Senior Toolpusher
2	Toolpushers
2	Drillers
2	Assistant Drillers
4	Floorhands
1	Deck Supervisor
2	Roustabouts
1	Cementer
2	Mud Loggers
1	Mud Engineer
2	Dynamic Safety Technicians
1	Radio Operator
1	Crane Operator

NOTE: Once the emergency is clearly defined, the above personnel should then be transferred to the evacuation vessel if they will not be needed.

## APPENDIX SECTION C

### SECTION C-1

#### EQUIPMENT LIST AND INVENTORY

NO.	DESCRIPTION
215	30 Minute Pressure demand SCBA w/ Pigtail
50	Hose Line Work Unit w/Escapes Cylinder
6	8-Bottle Cascade of Breathing Air
2	8-Bottle Cascade of Breathing Air- Drill Floor
2	2-Bottle Cascade of Breathing Air- Cranes
3	Oxygen Resuscitator w/ Spare Cylinders
1	Breathing Air Compressors
6	Portable H <sub>2</sub> S Monitors Five Gas (H <sub>2</sub> S, LEL, CO, SO <sub>2</sub> , O <sub>2</sub> )
2	Sensidyne/Gastech Manual Pump Type Detectors
10	Boxes H <sub>2</sub> S Tubes 4L
10	Boxes H <sub>2</sub> S Tubes 4H
10	Boxes SO <sub>2</sub> Tubes 5M
8	Windsock(s) with Pole and Bracket
2	Megaphones (Bullhorn) w/Spare Batteries
4	4' x 8' H <sub>2</sub> S Marine Warning Signs
4	2' x 3' Red Warning Light Panels
8	Primary and Secondary Safe Briefing Area Signs
2	Flare Pistol 25mm, w/Flares
10	White Marker Boards with Erasers and Markers
4	Flashlights w/ spare batteries
2	Safety harness w/ 150' Safety Line
2	First Aid Kit, 24 piece
10	Operating Condition Signs for Work Areas
300	Mini Check
1	Air Lab/ Air Quality Test Kit

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#### DETECTION AND ALARM SYSTEMS

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NO.	DESCRIPTION
1	H <sub>2</sub> S Fixed Monitor w/24 Channel Rack
3	Remote Annunciator Display for Gas Detection (Drill Floor, ECR, Shell Drilling Foreman)
17	H <sub>2</sub> S Sensors for Fixed Monitor
4	Explosion Proof Dual Light/Siren
5	Hazardous Area Alarms
20	Indoor Alarms

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## EVACUATION VESSEL

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All personnel will have a self-contained breathing apparatus and H<sub>2</sub>S training.

Vessels will remain upwind or at a safe distance when not in use. Vessels coming alongside will use caution monitoring with detectors to insure H<sub>2</sub>S or SO<sub>2</sub> is not present. All personnel on the vessel will don SCBAs when approaching a rig to evacuate personnel when H<sub>2</sub>S is present at 20 ppm TWA<sub>15</sub> or SO<sub>2</sub> at 2ppm or greater.

<b>NO.</b>	<b>DESCRIPTION</b>
30	30-minute SCBA Units
6	10-minute SCBA work units
15	8-Bottle Cascade of Breathing Air
14	12-Main Manifold
2	Distribution Panels
162	3' – 5' Low Pressure Hose Lines
6	50' Low Pressure Hose Lines
2	100' Low Pressure Hose Lines

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## HELICOPTER

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Helicopters will not land if red lights are flashing indicating the presence of H<sub>2</sub>S. Radio communications will be made direct to the drillship to determine if the heliport is clear from H<sub>2</sub>S and SO<sub>2</sub>.

**SECTION C-2****NOBLE DRILLING SUPERINTENDENT'S CHECKLIST: SAFETY EQUIPMENT**

Item	Qty	Description	OK	Date Checked Remarks	OK	Date Checked Remarks
<b>1</b>	<b>2</b>	<b>SAFE BRIEFING AREAS</b>				
<b>2</b>	<b>1</b>	<b>H<sub>2</sub>S Safety Equipment Package</b>				
3	N/A	Sets MY-6 Warning Flags				
<b>4</b>	-	<b>Zinc Carbonate or Zinc Oxide Equivalent</b>				
<b>5</b>	-	<b>Continuous type H<sub>2</sub>S detectors as follows:</b>				
5-1		Aft Quarters				
5-2		Forward Quarters				
5-3		Quarters Intake				
5-4		Engine Room Intake				
5-5		Sack Room				
5-6		Bridge Intake				
5-7		Possum Belly				
5-8		Mud Return				
5-9		Trip Tank				
5-10		Mud Pitts				
5-11		Pump Room				
5-12		Driller's Cabin				
5-13		Cement Unit				
5-14		Shale Shaker				
5-15		Shale Shaker				
5-16		Bell Nipple				
5-17		Moon Pool				

Item	Qty	Description	OK	Date Checked Remarks	OK	Date Checked Remarks
6	N/A	Electric fans — Placed as follows:				
		1. Rig Floor				
		2. Shale Shaker Area				
		3. Mud Pit and Storage Area				
7	1	<b>Forced Air Control Switch in Mudlogging Unit</b>				
8	-	<b>Safety equipment – as specified in inventory lists</b>	_____	_____	_____	_____

\*\* For more information on these safety equipment items, see Section II, "SAFETY EQUIPMENT".

**SECTION C-3****SAFETY EQUIPMENT CHECKLIST – MUDLOGGER**

To be checked and maintained by Mudlogger

Item	Qty	Description	OK	Date Checked Remarks	OK	Date Checked Remarks
1	2	Self-contained breathing apparatus for all Mud Loggers				
2	1	Switch inside the unit that controls the forced air duct into the unit				
3	1	Multi-gas Detector w/ H <sub>2</sub> S				

**SECTION C-4****SAFETY EQUIPMENT CHECKLIST – H<sub>2</sub>S SAFETY TECHNICIAN**To be Checked and Maintained by H<sub>2</sub>S Safety Technician

Item	Qty	Description	OK	Date Checked Remarks	OK	Date Checked Remarks
1	All	The continuous type monitoring units as described in this plan				
2	All	Breathing Air Cascade System				
3	All	H <sub>2</sub> S Alarm System as described in this plan				
4	-	Self-contained Breathing Apparatus for all H <sub>2</sub> S Safety Technicians				
5	All	SCBA for Drillship				



**SECTION C-5****SAFETY EQUIPMENT CHECKLIST – MUD ENGINEER**

To be checked and maintained  
By Mud Engineer

Item	Qty	Description	OK	Date Checked Remarks	OK	Date Checked Remarks
1	1	Self-contained breathing apparatus for all mud engineers				
2	-	100% zinc basic carbonate or zinc oxide or equivalent				
3	1	Garrett gas train units				
4						

**SECTION C-6****SHELL CHECKLIST OF ROUTINE DUTIES****Perform each week:**

1. Check volume of propane supply for flare ignitors and make sure lines are not plugged. Light each burner to verify system. (Backup ignition will be available)
2. Check all SCBA units for operation: pressure demand regulator, escape bottle air volume, supply bottle air volume.
3. Check breathing equipment mask assembly to see that straps are loosened and turned back ready to put on.
4. Check pressure on breathing equipment air bottles to make sure they are charged to full volume.
5. Check breathing equipment air bottles to make sure all pressure demand regulators are working. This requires that the bottle is opened and the mask assembly be put on tight enough so that air flows when inhaling. Open one side of mask to be sure air is pressured.
6. Confirm pressure on all air supply bottles.
7. Perform breathing equipment drills with all on-board personnel.
8. Check oxygen resuscitators for pressure in oxygen bottle and make sure demand regulator is working.
9. Check the following supplies for availability:
  - a. Stretcher
  - b. Spot Check Detectors
  - c. Safety belts and ropes
  - d. Flare gun and flares.
  - e. Emergency telephone lists
  - f. Spare Air bottles
  - g. Spare Oxygen Bottles
  - h. Detectors and Tubes
10. Test the explosion meter to verify that the batteries are good.

## SECTION D RULES AND REGULATIONS

### SECTION D-1

#### 30 CFR §250.490 Hydrogen Sulfide Regulations

(a) *What precautions must I take when operating in an H<sub>2</sub>S area?* You must:

(1) Take all necessary and feasible precautions and measures to protect personnel from the toxic effects of H<sub>2</sub>S and to mitigate damage to property and the environment caused by H<sub>2</sub>S. You must follow the requirements of this section when conducting drilling, well-completion/well-workover, and production operations in zones with H<sub>2</sub>S present and when conducting operations in zones where the presence of H<sub>2</sub>S is unknown. You do not need to follow these requirements when operating in zones where the absence of H<sub>2</sub>S has been confirmed; and

(2) Follow your approved contingency plan.

(b) *Definitions.* Terms used in this section have the following meanings:

*Facility* means a vessel, a structure, or an artificial island used for drilling, well-completion, well-workover, and/or production operations.

*H<sub>2</sub>S absent* means:

(1) Drilling, logging, coring, testing, or producing operations have confirmed the absence of H<sub>2</sub>S in concentrations that could potentially result in atmospheric concentrations of 20 ppm or more of H<sub>2</sub>S; or

(2) Drilling in the surrounding areas and correlation of geological and seismic data with equivalent stratigraphic units have confirmed an absence of H<sub>2</sub>S throughout the area to be drilled.

*H<sub>2</sub>S present* means that drilling, logging, coring, testing, or producing operations have confirmed the presence of H<sub>2</sub>S in concentrations and volumes that could potentially result in atmospheric concentrations of 20 ppm or more of H<sub>2</sub>S.

*H<sub>2</sub>S unknown* means the designation of a zone or geologic formation where neither the presence nor absence of H<sub>2</sub>S has been confirmed.

*Well-control fluid* means drilling mud and completion or workover fluid as appropriate to the particular operation being conducted.

(c) *Classifying an area for the presence of H<sub>2</sub>S.* You must:

(1) Request and obtain an approved classification for the area from the Regional Supervisor before you begin operations. Classifications are “H<sub>2</sub>S absent,” H<sub>2</sub>S present,” or “H<sub>2</sub>S unknown”;

(2) Submit your request with your application for permit to drill;

(3) Support your request with available information such as geologic and geophysical data and correlations, well logs, formation tests, cores and analysis of formation fluids; and

(4) Submit a request for reclassification of a zone when additional data indicate a different classification is needed.

(d) *What do I do if conditions change?* If you encounter H<sub>2</sub>S that could potentially result in atmospheric concentrations of 20 ppm or more in areas not previously classified as having H<sub>2</sub>S present, you must immediately notify BOE and begin to follow requirements for areas with H<sub>2</sub>S present.

(e) *What are the requirements for conducting simultaneous operations?* When conducting any combination of drilling, well-completion, well-workover, and production operations simultaneously, you must follow the requirements in the section applicable to each individual operation.

(f) *Requirements for submitting an H<sub>2</sub> S Contingency Plan.* Before you begin operations, you must submit an H<sub>2</sub>S Contingency Plan to the District Manager for approval. Do not begin operations before the District Manager approves your plan. You must keep a copy of the approved plan in the field, and you must follow the plan at all times. Your plan must include:

(1) Safety procedures and rules that you will follow concerning equipment, drills, and smoking;

(2) Training you provide for employees, contractors, and visitors;

(3) Job position and title of the person responsible for the overall safety of personnel;

(4) Other key positions, how these positions fit into your organization, and what the functions, duties, and responsibilities of those job positions are;

(5) Actions that you will take when the concentration of H<sub>2</sub>S in the atmosphere reaches 20 ppm, who will be responsible for those actions, and a description of the audible and visual alarms to be activated;

(6) Briefing areas where personnel will assemble during an H<sub>2</sub>S alert. You must have at least two briefing areas on each facility and use the briefing area that is upwind of the H<sub>2</sub>S source at any given time;

(7) Criteria you will use to decide when to evacuate the facility and procedures you will use to safely evacuate all personnel from the facility by vessel, capsule, or lifeboat. If you use helicopters during H<sub>2</sub>S alerts, describe the types of H<sub>2</sub>S emergencies during which you consider the risk of helicopter activity to be acceptable and the precautions you will take during the flights;

(8) Procedures you will use to safely position all vessels attendant to the facility. Indicate where you will locate the vessels with respect to wind direction. Include the distance from the facility and what procedures you will use to safely relocate the vessels in an emergency;

(9) How you will provide protective-breathing equipment for all personnel, including contractors and visitors;

- (10) The agencies and facilities you will notify in case of a release of H<sub>2</sub>S (that constitutes an emergency), how you will notify them, and their telephone numbers. Include all facilities that might be exposed to atmospheric concentrations of 20 ppm or more of H<sub>2</sub>S;
- (11) The medical personnel and facilities you will use if needed, their addresses, and telephone numbers;
- (12) H<sub>2</sub>S detector locations in production facilities producing gas containing 20 ppm or more of H<sub>2</sub>S. Include an "H<sub>2</sub>S Detector Location Drawing" showing:
- (i) All vessels, flare outlets, wellheads, and other equipment handling production containing H<sub>2</sub>S;
  - (ii) Approximate maximum concentration of H<sub>2</sub>S in the gas stream; and
  - (iii) Location of all H<sub>2</sub>S sensors included in your contingency plan;
- (13) Operational conditions when you expect to flare gas containing H<sub>2</sub>S including the estimated maximum gas flow rate, H<sub>2</sub>S concentration, and duration of flaring;
- (14) Your assessment of the risks to personnel during flaring and what precautionary measures you will take;
- (15) Primary and alternate methods to ignite the flare and procedures for sustaining ignition and monitoring the status of the flare ( *i.e.* , ignited or extinguished);
- (16) Procedures to shut off the gas to the flare in the event the flare is extinguished;
- (17) Portable or fixed sulphur dioxide (SO<sub>2</sub>)-detection system(s) you will use to determine SO<sub>2</sub> concentration and exposure hazard when H<sub>2</sub>S is burned;
- (18) Increased monitoring and warning procedures you will take when the SO<sub>2</sub> concentration in the atmosphere reaches 2 ppm;
- (19) Personnel protection measures or evacuation procedures you will initiate when the SO<sub>2</sub> concentration in the atmosphere reaches 5 ppm;
- (20) Engineering controls to protect personnel from SO<sub>2</sub>; and
- (21) Any special equipment, procedures, or precautions you will use if you conduct any combination of drilling, well-completion, well-workover, and production operations simultaneously.
- (g) *Training program* —(1) *When and how often do employees need to be trained?* All Shells and contract personnel must complete an H<sub>2</sub>S training program to meet the requirements of this section:
- (i) Before beginning work at the facility; and
  - (ii) Each year, within 1 year after completion of the previous class.

(2) *What training documentation do I need?* For each individual working on the platform, either:

- (i) You must have documentation of this training at the facility where the individual is employed; or
- (ii) The employee must carry a training completion card.

(3) *What training do I need to give to visitors and employees previously trained on another facility?*

—(i) Trained employees or contractors transferred from another facility must attend a supplemental briefing on your H<sub>2</sub>S equipment and procedures before beginning duty at your facility;

(ii) Visitors who will remain on your facility more than 24 hours must receive the training required for employees by paragraph (g)(4) of this section; and

(iii) Visitors who will depart before spending 24 hours on the facility are exempt from the training required for employees, but they must, upon arrival, complete a briefing that includes:

(A) Information on the location and use of an assigned respirator; practice in donning and adjusting the assigned respirator; information on the safe briefing areas, alarm system, and hazards of H<sub>2</sub>S and SO<sub>2</sub>; and

(B) Instructions on their responsibilities in the event of an H<sub>2</sub>S release.

(4) *What training must I provide to all other employees?* You must train all individuals on your facility on the:

(i) Hazards of H<sub>2</sub>S and of SO<sub>2</sub> and the provisions for personnel safety contained in the H<sub>2</sub>S Contingency Plan;

(ii) Proper use of safety equipment which the employee may be required to use;

(iii) Location of protective breathing equipment, H<sub>2</sub>S detectors and alarms, ventilation equipment, briefing areas, warning systems, evacuation procedures, and the direction of prevailing winds;

(iv) Restrictions and corrective measures concerning beards, spectacles, and contact lenses in conformance with ANSI Z88.2, American National Standard for Respiratory Protection (incorporated by reference as specified in §250.198);

(v) Basic first-aid procedures applicable to victims of H<sub>2</sub>S exposure. During all drills and training sessions, you must address procedures for rescue and first aid for H<sub>2</sub>S victims;

(vi) Location of:

(A) The first-aid kit on the facility;

(B) Resuscitators; and

(C) Litter or other device on the facility.

(vii) Meaning of all warning signals.

(5) *Do I need to post safety information?* You must prominently post safety information on the facility and on vessels serving the facility ( i.e. , basic first-aid, escape routes, instructions for use of life boats, etc.).

(h) *Drills. (1) When and how often do I need to conduct drills on H<sub>2</sub> S safety discussions on the facility?* You must:

(i) Conduct a drill for each person at the facility during normal duty hours at least once every 7-day period. The drills must consist of a dry-run performance of personnel activities related to assigned jobs.

(ii) At a safety meeting or other meetings of all personnel, discuss drill performance, new H<sub>2</sub>S considerations at the facility, and other updated H<sub>2</sub>S information at least monthly.

(2) *What documentation do I need?* You must keep records of attendance for:

(i) Drilling, well-completion, and well-workover operations at the facility until operations are completed; and

(ii) Production operations at the facility or at the nearest field office for 1 year.

(i) *Visual and audible warning systems —(1) How must I install wind direction equipment?* You must install wind-direction equipment in a location visible at all times to individuals on or in the immediate vicinity of the facility.

(2) *When do I need to display operational danger signs, display flags, or activate visual or audible alarms?* —(i) You must display warning signs at all times on facilities with wells capable of producing H<sub>2</sub>S and on facilities that process gas containing H<sub>2</sub>S in concentrations of 20 ppm or more.

(ii) In addition to the signs, you must activate audible alarms and display flags or activate flashing red lights when atmospheric concentration of H<sub>2</sub>S reaches 20 ppm.

(3) *What are the requirements for signs?* Each sign must be a high-visibility yellow color with black lettering as follows:

Letter height	Wording
12 inches	Danger.
	Poisonous Gas.
	Hydrogen Sulfide.
7 inches	Do not approach if red flag is flying.
(Use appropriate wording at right)	Do not approach if red lights are flashing.

(4) *May I use existing signs?* You may use existing signs containing the words “Danger-Hydrogen Sulfide-H<sub>2</sub>S,” provided the words “Poisonous Gas. Do Not Approach if Red Flag is Flying” or “Red Lights are Flashing” in lettering of a minimum of 7 inches in height are displayed on a sign immediately adjacent to the existing sign.

(5) *What are the requirements for flashing lights or flags?* You must activate a sufficient number of lights or hoist a sufficient number of flags to be visible to vessels and aircraft. Each light must be of sufficient intensity to be seen by approaching vessels or aircraft any time it is activated (day or night). Each flag must be red, rectangular, a minimum width of 3 feet, and a minimum height of 2 feet.

(6) *What is an audible warning system?* An audible warning system is a public address system or siren, horn, or other similar warning device with a unique sound used only for H<sub>2</sub>S.

(7) *Are there any other requirements for visual or audible warning devices?* Yes, you must:

- (i) Illuminate all signs and flags at night and under conditions of poor visibility; and
- (ii) Use warning devices that are suitable for the electrical classification of the area.

(8) *What actions must I take when the alarms are activated?* When the warning devices are activated, the designated responsible persons must inform personnel of the level of danger and issue instructions on the initiation of appropriate protective measures.

(j) *H<sub>2</sub>S-detection and H<sub>2</sub>S monitoring equipment* —(1) *What are the requirements for an H<sub>2</sub>S detection system?* An H<sub>2</sub>S detection system must:

- (i) Be capable of sensing a minimum of 10 ppm of H<sub>2</sub>S in the atmosphere; and
- (ii) Activate audible and visual alarms when the concentration of H<sub>2</sub>S in the atmosphere reaches 20 ppm.

(2) *Where must I have sensors for drilling, well-completion, and well-workover operations?* You must locate sensors at the:

- (i) Bell nipple;
- (ii) Mud-return line receiver tank (possum belly);
- (iii) Pipe-trip tank;
- (iv) Shale shaker;
- (v) Well-control fluid pit area;
- (vi) Driller's station;
- (vii) Living quarters; and



(viii) All other areas where H<sub>2</sub>S may accumulate.

(3) *Do I need mud sensors?* The District Manager may require mud sensors in the possum belly in cases where the ambient air sensors in the mud-return system do not consistently detect the presence of H<sub>2</sub>S.

(4) *How often must I observe the sensors?* During drilling, well-completion and well-workover operations, you must continuously observe the H<sub>2</sub>S levels indicated by the monitors in the work areas during the following operations:

(i) When you pull a wet string of drill pipe or workover string;

(ii) When circulating bottoms-up after a drilling break;

(iii) During cementing operations;

(iv) During logging operations; and

(v) When circulating to condition mud or other well-control fluid.

(5) *Where must I have sensors for production operations?* On a platform where gas containing H<sub>2</sub>S of 20 ppm or greater is produced, processed, or otherwise handled:

(i) You must have a sensor in rooms, buildings, deck areas, or low-laying deck areas not otherwise covered by paragraph (j)(2) of this section, where atmospheric concentrations of H<sub>2</sub>S could reach 20 ppm or more. You must have at least one sensor per 400 square feet of deck area or fractional part of 400 square feet;

(ii) You must have a sensor in buildings where personnel have their living quarters;

(iii) You must have a sensor within 10 feet of each vessel, compressor, wellhead, manifold, or pump, which could release enough H<sub>2</sub>S to result in atmospheric concentrations of 20 ppm at a distance of 10 feet from the component;

(iv) You may use one sensor to detect H<sub>2</sub>S around multiple pieces of equipment, provided the sensor is located no more than 10 feet from each piece, except that you need to use at least two sensors to monitor compressors exceeding 50 horsepower;

(v) You do not need to have sensors near wells that are shut in at the master valve and sealed closed;

(vi) When you determine where to place sensors, you must consider:

(A) The location of system fittings, flanges, valves, and other devices subject to leaks to the atmosphere; and

(B) Design factors, such as the type of decking and the location of fire walls; and

(vii) The District Manager may require additional sensors or other monitoring capabilities, if warranted by site specific conditions.

(6) *How must I functionally test the H<sub>2</sub>S Detectors?* —(i) Personnel trained to calibrate the particular H<sub>2</sub>S detector equipment being used must test detectors by exposing them to a known concentration in the range of 10 to 30 ppm of H<sub>2</sub>S.

(ii) If the results of any functional test are not within 2 ppm or 10 percent, whichever is greater, of the applied concentration, recalibrate the instrument.

(7) *How often must I test my detectors?* —(i) When conducting drilling, drill stem testing, well-completion, or well-workover operations in areas classified as H<sub>2</sub>S present or H<sub>2</sub>S unknown, test all detectors at least once every 24 hours. When drilling, begin functional testing before the bit is 1,500 feet (vertically) above the potential H<sub>2</sub>S zone.

(ii) When conducting production operations, test all detectors at least every 14 days between tests.

(iii) If equipment requires calibration as a result of two consecutive functional tests, the District Manager may require that H<sub>2</sub>S-detection and H<sub>2</sub>S-monitoring equipment be functionally tested and calibrated more frequently.

(8) *What documentation must I keep?* —(i) You must maintain records of testing and calibrations (in the drilling or production operations report, as applicable) at the facility to show the present status and history of each device, including dates and details concerning:

(A) Installation;

(B) Removal;

(C) Inspection;

(D) Repairs;

(E) Adjustments; and

(F) Reinstallation.

(ii) Records must be available for inspection by BOE personnel.

(9) *What are the requirements for nearby vessels?* If vessels are stationed overnight alongside facilities in areas of H<sub>2</sub>S present or H<sub>2</sub>S unknown, you must equip vessels with an H<sub>2</sub>S-detection system that activates audible and visual alarms when the concentration of H<sub>2</sub>S in the atmosphere reaches 20 ppm. This requirement does not apply to vessels positioned upwind and at a safe distance from the facility in accordance with the positioning procedure described in the approved H<sub>2</sub>S Contingency Plan.

(10) *What are the requirements for nearby facilities?* The District Manager may require you to equip nearby facilities with portable or fixed H<sub>2</sub>S detector(s) and to test and calibrate those detectors. To

invoke this requirement, the District Manager will consider dispersion modeling results from a possible release to determine if 20 ppm H<sub>2</sub>S concentration levels could be exceeded at nearby facilities.

(11) *What must I do to protect against SO<sub>2</sub> if I burn gas containing H<sub>2</sub>S?* You must:

(i) Monitor the SO<sub>2</sub> concentration in the air with portable or strategically placed fixed devices capable of detecting a minimum of 2 ppm of SO<sub>2</sub>;

(ii) Take readings at least hourly and at any time personnel detect SO<sub>2</sub> odor or nasal irritation;

(iii) Implement the personnel protective measures specified in the H<sub>2</sub>S Contingency Plan if the SO<sub>2</sub> concentration in the work area reaches 2 ppm; and

(iv) Calibrate devices every 3 months if you use fixed or portable electronic sensing devices to detect SO<sub>2</sub>.

(12) *May I use alternative measures?* You may follow alternative measures instead of those in paragraph (j)(11) of this section if you propose and the Regional Supervisor approves the alternative measures.

(13) *What are the requirements for protective-breathing equipment?* In an area classified as H<sub>2</sub>S present or H<sub>2</sub>S unknown, you must:

(i) Provide all personnel, including contractors and visitors on a facility, with immediate access to self-contained pressure-demand-type respirators with hoseline capability and breathing time of at least 15 minutes.

(ii) Design, select, use, and maintain respirators in conformance with ANSI Z88.2 (incorporated by reference as specified in §250.198).

(iii) Make available at least two voice-transmission devices, which can be used while wearing a respirator, for use by designated personnel.

(iv) Make spectacle kits available as needed.

(v) Store protective-breathing equipment in a location that is quickly and easily accessible to all personnel.

(vi) Label all breathing-air bottles as containing breathing-quality air for human use.

(vii) Ensure that vessels attendant to facilities carry appropriate protective-breathing equipment for each crew member. The District Manager may require additional protective-breathing equipment on certain vessels attendant to the facility.

(viii) During H<sub>2</sub>S alerts, limit helicopter flights to and from facilities to the conditions specified in the H<sub>2</sub>S Contingency Plan. During authorized flights, the flight crew and passengers must use pressure-

demand-type respirators. You must train all members of flight crews in the use of the particular type(s) of respirator equipment made available.

(ix) As appropriate to the particular operation(s), (production, drilling, well-completion or well-workover operations, or any combination of them), provide a system of breathing-air manifolds, hoses, and masks at the facility and the briefing areas. You must provide a cascade air-bottle system for the breathing-air manifolds to refill individual protective-breathing apparatus bottles. The cascade air-bottle system may be recharged by a high-pressure compressor suitable for providing breathing-quality air, provided the compressor suction is located in an uncontaminated atmosphere.

(k) *Personnel safety equipment* —(1) *What additional personnel-safety equipment do I need?* You must ensure that your facility has:

(i) Portable H<sub>2</sub>S detectors capable of detecting a 10 ppm concentration of H<sub>2</sub>S in the air available for use by all personnel;

(ii) Retrieval ropes with safety harnesses to retrieve incapacitated personnel from contaminated areas;

(iii) Chalkboards and/or note pads for communication purposes located on the rig floor, shale-shaker area, the cement-pump rooms, well-bay areas, production processing equipment area, gas compressor area, and pipeline-pump area;

(iv) Bull horns and flashing lights; and

(v) At least three resuscitators on manned facilities, and a number equal to the personnel on board, not to exceed three, on normally unmanned facilities, complete with face masks, oxygen bottles, and spare oxygen bottles.

(2) *What are the requirements for ventilation equipment?* You must:

(i) Use only explosion-proof ventilation devices;

(ii) Install ventilation devices in areas where H<sub>2</sub>S or SO<sub>2</sub> may accumulate; and

(iii) Provide movable ventilation devices in work areas. The movable ventilation devices must be multidirectional and capable of dispersing H<sub>2</sub>S or SO<sub>2</sub> vapors away from working personnel.

(3) *What other personnel safety equipment do I need?* You must have the following equipment readily available on each facility:

(i) A first-aid kit of appropriate size and content for the number of personnel on the facility; and

(ii) At least one litter or an equivalent device.

(l) *Do I need to notify MMS in the event of an H<sub>2</sub>S release?* You must notify MMS without delay in the event of a gas release which results in a 15-minute time-weighted average atmospheric concentration of H<sub>2</sub>S of 20 ppm or more anywhere on the OCS facility. You must report these gas

releases to the District Manager immediately by oral communication, with a written follow-up report within 15 days, pursuant to §§250.188 through 250.190.

(m) *Do I need to use special drilling, completion and workover fluids or procedures?* When working in an area classified as H<sub>2</sub>S present or H<sub>2</sub>S unknown:

(1) You may use either water- or oil-base muds in accordance with §250.300(b)(1).

(2) If you use water-base well-control fluids, and if ambient air sensors detect H<sub>2</sub>S, you must immediately conduct either the Garrett-Gas-Train test or a comparable test for soluble sulfides to confirm the presence of H<sub>2</sub>S.

(3) If the concentration detected by air sensors is over 20 ppm, personnel conducting the tests must don protective-breathing equipment conforming to paragraph (j)(13) of this section.

(4) You must maintain on the facility sufficient quantities of additives for the control of H<sub>2</sub>S, well-control fluid pH, and corrosion equipment.

(i) *Scavengers.* You must have scavengers for control of H<sub>2</sub>S available on the facility. When H<sub>2</sub>S is detected, you must add scavengers as needed. You must suspend drilling until the scavenger is circulated throughout the system.

(ii) *Control pH.* You must add additives for the control of pH to water-base well-control fluids in sufficient quantities to maintain pH of at least 10.0.

(iii) *Corrosion inhibitors.* You must add additives to the well-control fluid system as needed for the control of corrosion.

(5) You must degas well-control fluids containing H<sub>2</sub>S at the optimum location for the particular facility. You must collect the gases removed and burn them in a closed flare system conforming to paragraph (q)(6) of this section.

(n) *What must I do in the event of a kick?* In the event of a kick, you must use one of the following alternatives to dispose of the well-influx fluids giving consideration to personnel safety, possible environmental damage, and possible facility well-equipment damage:

(1) Contain the well-fluid influx by shutting in the well and pumping the fluids back into the formation.

(2) Control the kick by using appropriate well-control techniques to prevent formation fracturing in an open hole within the pressure limits of the well equipment (drill pipe, work string, casing, wellhead, BOP system, and related equipment). The disposal of H<sub>2</sub>S and other gases must be through pressurized or atmospheric mud-separator equipment depending on volume, pressure and concentration of H<sub>2</sub>S. The equipment must be designed to recover well-control fluids and burn the gases separated from the well-control fluid. The well-control fluid must be treated to neutralize H<sub>2</sub>S and restore and maintain the proper quality.

(o) *Well testing in a zone known to contain H<sub>2</sub>S.* When testing a well in a zone with H<sub>2</sub>S present, you must do all of the following:

- (1) Before starting a well test, conduct safety meetings for all personnel who will be on the facility during the test. At the meetings, emphasize the use of protective-breathing equipment, first-aid procedures, and the Contingency Plan. Only competent personnel who are trained and are knowledgeable of the hazardous effects of H<sub>2</sub>S must be engaged in these tests.
  - (2) Perform well testing with the minimum number of personnel in the immediate vicinity of the rig floor and with the appropriate test equipment to safely and adequately perform the test. During the test, you must continuously monitor H<sub>2</sub>S levels.
  - (3) Not burn produced gases except through a flare which meets the requirements of paragraph (q)(6) of this section. Before flaring gas containing H<sub>2</sub>S, you must activate SO<sub>2</sub> monitoring equipment in accordance with paragraph (j)(11) of this section. If you detect SO<sub>2</sub> in excess of 2 ppm, you must implement the personnel protective measures in your H<sub>2</sub>S Contingency Plan, required by paragraph (f) of this section. You must also follow the requirements of §250.1105. You must pipe gases from stored test fluids into the flare outlet and burn them.
  - (4) Use downhole test tools and wellhead equipment suitable for H<sub>2</sub>S service.
  - (5) Use tubulars suitable for H<sub>2</sub>S service. You must not use drill pipe for well testing without the prior approval of the District Manager. Water cushions must be thoroughly inhibited in order to prevent H<sub>2</sub>S attack on metals. You must flush the test string fluid treated for this purpose after completion of the test.
  - (6) Use surface test units and related equipment that is designed for H<sub>2</sub>S service.
- (p) *Metallurgical properties of equipment.* When operating in a zone with H<sub>2</sub>S present, you must use equipment that is constructed of materials with metallurgical properties that resist or prevent sulfide stress cracking (also known as hydrogen embrittlement, stress corrosion cracking, or H<sub>2</sub>S embrittlement), chloride-stress cracking, hydrogen-induced cracking, and other failure modes. You must do all of the following:
- (1) Use tubulars and other equipment, casing, tubing, drill pipe, couplings, flanges, and related equipment that is designed for H<sub>2</sub>S service.
  - (2) Use BOP system components, wellhead, pressure-control equipment, and related equipment exposed to H<sub>2</sub>S-bearing fluids in conformance with NACE Standard MR0175–03 (incorporated by reference as specified in §250.198).
  - (3) Use temporary downhole well-security devices such as retrievable packers and bridge plugs that are designed for H<sub>2</sub>S service.
  - (4) When producing in zones bearing H<sub>2</sub>S, use equipment constructed of materials capable of resisting or preventing sulfide stress cracking.
  - (5) Keep the use of welding to a minimum during the installation or modification of a production facility. Welding must be done in a manner that ensures resistance to sulfide stress cracking.

(q) *General requirements when operating in an H<sub>2</sub>S zone* —(1) *Coring operations.* When you conduct coring operations in H<sub>2</sub>S-bearing zones, all personnel in the working area must wear protective-breathing equipment at least 10 stands in advance of retrieving the core barrel. Cores to be transported must be sealed and marked for the presence of H<sub>2</sub>S.

(2) *Logging operations.* You must treat and condition well-control fluid in use for logging operations to minimize the effects of H<sub>2</sub>S on the logging equipment.

(3) *Stripping operations.* Personnel must monitor displaced well-control fluid returns and wear protective-breathing equipment in the working area when the atmospheric concentration of H<sub>2</sub>S reaches 20 ppm or if the well is under pressure.

(4) *Gas-cut well-control fluid or well kick from H<sub>2</sub>S-bearing zone.* If you decide to circulate out a kick, personnel in the working area during bottoms-up and extended-kill operations must wear protective-breathing equipment.

(5) *Drill- and workover-string design and precautions.* Drill- and workover-strings must be designed consistent with the anticipated depth, conditions of the hole, and reservoir environment to be encountered. You must minimize exposure of the drill- or workover-string to high stresses as much as practical and consistent with well conditions. Proper handling techniques must be taken to minimize notching and stress concentrations. Precautions must be taken to minimize stresses caused by doglegs, improper stiffness ratios, improper torque, whip, abrasive wear on tool joints, and joint imbalance.

(6) *Flare system.* The flare outlet must be of a diameter that allows easy nonrestricted flow of gas. You must locate flare line outlets on the downside of the facility and as far from the facility as is feasible, taking into account the prevailing wind directions, the wake effects caused by the facility and adjacent structure(s), and the height of all such facilities and structures. You must equip the flare outlet with an automatic ignition system including a pilot-light gas source or an equivalent system. You must have alternate methods for igniting the flare. You must pipe to the flare system used for H<sub>2</sub>S all vents from production process equipment, tanks, relief valves, burst plates, and similar devices.

(7) *Corrosion mitigation.* You must use effective means of monitoring and controlling corrosion caused by acid gases (H<sub>2</sub>S and CO<sub>2</sub>) in both the downhole and surface portions of a production system. You must take specific corrosion monitoring and mitigating measures in areas of unusually severe corrosion where accumulation of water and/or higher concentration of H<sub>2</sub>S exists.

(8) *Wireline lubricators.* Lubricators which may be exposed to fluids containing H<sub>2</sub>S must be of H<sub>2</sub>S-resistant materials.

(9) *Fuel and/or instrument gas.* You must not use gas containing H<sub>2</sub>S for instrument gas. You must not use gas containing H<sub>2</sub>S for fuel gas without the prior approval of the District Manager.

(10) *Sensing lines and devices.* Metals used for sensing line and safety-control devices which are necessarily exposed to H<sub>2</sub>S-bearing fluids must be constructed of H<sub>2</sub>S-corrosion resistant materials or coated so as to resist H<sub>2</sub>S corrosion.

(11) *Elastomer seals*. You must use H<sub>2</sub>S-resistant materials for all seals which may be exposed to fluids containing H<sub>2</sub>S.

(12) *Water disposal*. If you dispose of produced water by means other than subsurface injection, you must submit to the District Manager an analysis of the anticipated H<sub>2</sub>S content of the water at the final treatment vessel and at the discharge point. The District Manager may require that the water be treated for removal of H<sub>2</sub>S. The District Manager may require the submittal of an updated analysis if the water disposal rate or the potential H<sub>2</sub>S content increases.

(13) *Deck drains*. You must equip open deck drains with traps or similar devices to prevent the escape of H<sub>2</sub>S gas into the atmosphere.

(14) *Sealed voids*. You must take precautions to eliminate sealed spaces in piping designs (e.g., slip-on flanges, reinforcing pads) which can be invaded by atomic hydrogen when H<sub>2</sub>S is present.

[62 FR 3795, Jan. 27, 1997. Redesignated and amended at 63 FR 29479, 29485, May 29, 1998; 65 FR 15864, Mar. 24, 2000. Redesignated and amended at 68 FR 8423, 8434, Feb. 20, 2003; 71 FR 19645, Apr. 17, 2006; 72 FR 12096, Mar. 15, 2007; 72 FR 25201, May 4, 2007]



**SECTION D-2****HYDROGEN SULFIDE PINC LIST**

**This Section Pertains to Areas Classified as H<sub>2</sub>S *Present* and H<sub>2</sub>S *Unknown*.**

**Definitions: H<sub>2</sub>S *present* means that drilling, logging, coring, testing, or producing operations have confirmed the presence of H<sub>2</sub>S in concentrations and volumes that could potentially result in atmospheric concentrations of 20 ppm or more of H<sub>2</sub>S.**

**H<sub>2</sub>S *unknown* means the designation of a zone or geological formation where neither the presence nor absence of H<sub>2</sub>S has been confirmed.**

**H-100**

**IS A COPY OF THE APPROVED H<sub>2</sub>S CONTINGENCY PLAN AVAILABLE IN THE FIELD AREA, AND IS THAT PLAN BEING FOLLOWED?**

**Authority: 490(f)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

Verify that an approved plan is available and being followed at the facility at the commencement of and throughout all operations during which the H<sub>2</sub>S Contingency Plan is in effect.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if an H<sub>2</sub>S Contingency Plan is not available.

Issue a facility shut-in (**S**) INC if there is not an approved plan or the plan is not being followed.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-101**

**ARE AT LEAST TWO SAFE BRIEFING AREAS ESTABLISHED?**

**Authority: 490(f)(6)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

1. Verify that designated safe briefing areas at the facility are as designated in the approved H<sub>2</sub>S Contingency Plan.

2. Verify that designated safe briefing area during the inspection period is upwind of operations.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if safe briefing areas:

1. Are not as approved,
2. Have not been established, or
3. During inspection, is not upwind of operations.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-102**

**ARE ALL PERSONNEL INFORMED OF THE HAZARDS OF H<sub>2</sub>S AND OF SO<sub>2</sub> RESULTING FROM BURNING H<sub>2</sub>S, AND INSTRUCTED IN THE PROVISIONS FOR PERSONNEL SAFETY CONTAINED IN THE H<sub>2</sub>S CONTINGENCY PLAN?**

**Authority: 490(g)(4)(i)**

**Enforcement Action: C**

**490(j)(11)(iii)****INSPECTION PROCEDURE:**

Inspect training session records to verify that personnel were instructed and informed as required.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC to remove any person from the facility that has not received the required instructions.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-103****ARE ALL PERSONNEL INSTRUCTED IN THE USE OF SAFETY EQUIPMENT WHICH THEY MAY BE REQUIRED TO USE?**

**Authority:** 490(g)(4)(ii)

**Enforcement Action:** C

**INSPECTION PROCEDURE:**

Inspect training session records to verify that all personnel were instructed and informed as required.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC to remove any personnel from the facility that have not received the required instructions.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-104****ARE ALL PERSONNEL INFORMED OF THE LOCATION OF PROTECTIVE-BREATHING EQUIPMENT, H<sub>2</sub>S DETECTORS AND ALARMS, VENTILATION EQUIPMENT, BRIEFING AREAS, WARNING SYSTEMS, EVACUATION PROCEDURES, AND THE DIRECTION OF THE PREVAILING WINDS?**

**Authority:** 490(g)(4)(iii)

**Enforcement Action:** C

**INSPECTION PROCEDURE:**

Inspect training session records to verify that all personnel were instructed and informed as required.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC to remove any personnel from the facility that has not received the required instructions.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-105****ARE ALL PERSONNEL INFORMED OF THE RESTRICTIONS AND CORRECTIVE MEASURES CONCERNING BEARDS, SPECTACLES, AND CONTACT LENSES IN CONFORMANCE WITH ANSI Z88.2?**

**Authority:** 198(e)

**Enforcement Action:** C

**490(g)(4)(iv)**

**INSPECTION PROCEDURE:**

Inspect training session records to verify that all personnel were instructed and informed as required.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC to remove any personnel from the facility that have not received the required instructions.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-106**

**IS SAFETY INFORMATION PROMINENTLY POSTED ON THE FACILITY?**

**Authority: 490(g)(5)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually observe the facility to verify the posting of safety information.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if safety information is not prominently posted on the facility.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-107**

**IS SAFETY INFORMATION PROMINENTLY POSTED ON VESSELS SERVING THE FACILITY?**

**Authority: 490(g)(5)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually inspect the vessel to verify the posting of safety information.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if safety information is not prominently posted on vessels serving the facility.

**INSPECTION FORM:**

Enter one item checked for each vessel inspected.

**H-108**

**DO ALL SHELL AND CONTRACT PERSONNEL RECEIVE A TRAINING SESSION BEFORE BEGINNING WORK AT THE FACILITY AND AGAIN WITHIN 1 YEAR AFTER COMPLETION OF THE PREVIOUS CLASS?**

**Authority: 490(g)(1)(i)**

**Enforcement Action: C**

**490(g)(1)(ii)**

**INSPECTION PROCEDURE:**

1. Verify that all Shell and contract personnel arriving at the facility have received a training session before beginning work.
2. Verify that the Shell and contract personnel have again received that training within 1 year after completion of the previous class.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC if, during the inspection, the inspector observes any Shell or contract personnel arriving at the facility who does not receive a training session before beginning work or has not received that training within 1 year after completion of the previous class.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-109**

**DOES EACH PERSON PARTICIPATE IN A DRILL DURING NORMAL DUTY HOURS AT LEAST ONCE EVERY 7-DAY PERIOD?**

**Authority: 490(h)(1)(i)**

**Enforcement Action: W/C**

**INSPECTION PROCEDURE:**

Verify that all personnel have participated in a drill during normal duty hours at least once in every 7-day period after duty begins.

**Note:** Duty begins upon arrival at the facility.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records do not indicate that any person(s) did not participate in a drill at least once in every 7-day period after duty began.

Issue a component shut-in (**C**) INC if individual personnel has not participated in a drill during normal duty hours at least once every 7-day period.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-111**

**ARE RECORDS OF ATTENDANCE FOR TRAINING MAINTAINED AT THE FACILITY OR DOES THE EMPLOYEE CARRY A TRAINING COMPLETION CARD?**

**Authority: 490(g)(2)(i)**

**Enforcement Action: W**

**490(g)(2)(ii)**

**INSPECTION PROCEDURE:**

Request to see the records of attendance at the weekly drills and training sessions.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if:

1. The records are not available.
2. The records are incomplete.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-113**

**IS A FIRST-AID KIT, OF APPROPRIATE SIZE AND CONTENT, READILY AVAILABLE FOR THE NUMBER OF PERSONNEL ON THE FACILITY?**

**Authority: 490(k)(3)(i)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that a first-aid kit of appropriate size and content is readily available.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if:

1. There is no first-aid kit.
2. The first-aid kit is of insufficient size or content.
3. The first aid kit is not readily available.

**INSPECTION FORM:**

Enter one item checked for each kit inspected.

**H-114**

**ARE THERE AT LEAST THREE RESUSCITATORS ON MANNED FACILITIES, AND A NUMBER EQUAL TO THE PERSONNEL ON BOARD, NOT TO EXCEED THREE, ON NORMALLY UNMANNED FACILITIES (COMPLETE WITH FACE MASKS, OXYGEN BOTTLES, SPARE OXYGEN BOTTLES) AND ARE THESE ITEMS READILY AVAILABLE?**

**Authority: 490(k)(1)(v)**

**Enforcement Action: C**

**INSPECTION PROCEDURE:**

1. Visually inspect the facility to verify that at least three resuscitators complete with a face mask and oxygen bottle are available.
2. Visually inspect the facility to verify that spare oxygen bottles are readily available.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (C) INC if:

1. The facility is not equipped with at least three resuscitators complete with face masks and oxygen bottles.
2. The facility does not have spare oxygen bottles.
3. The resuscitators and oxygen bottles are not readily available.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-115**

**IS THERE AT LEAST ONE LITTER OR AN EQUIVALENT DEVICE ON THE FACILITY AND READILY AVAILABLE FOR USE?**

**Authority: 490(k)(3)(ii)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that there is at least one litter or an equivalent device readily available on the facility.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if there is not at least one litter or an equivalent device readily available.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-117**

**IS WIND-DIRECTION EQUIPMENT INSTALLED IN LOCATIONS VISIBLE AT ALL TIMES TO INDIVIDUALS ON OR IN THE IMMEDIATE VICINITY OF THE FACILITY?**

**Authority: 490(i)(1)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Visually verify that visible wind-direction equipment has been installed at prominent locations. Wind direction equipment includes windsocks, flags, and streamers.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (S) INC if wind-direction equipment is not visible or has not been installed in prominent locations.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-118**

**ARE OPERATIONAL DANGER SIGNS DISPLAYED AT ALL TIMES ON FACILITIES WITH WELLS CAPABLE OF PRODUCING H<sub>2</sub>S GAS IN CONCENTRATIONS OF 20 PPM OR MORE?**

**Authority: 490(i)(2)(i)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Inspect the signs and flags to verify that installation is as required.

**Signs shall:**

1. Be installed on each side of the facility.
2. Be a minimum width of 8 feet and a minimum height of 4 feet.
3. Be a high visibility yellow color with black lettering a minimum of 12 inches in height.
4. Read "**DANGER - HYDROGEN SULFIDE - H<sub>2</sub>S**".
5. Be illuminated at night and under conditions of poor visibility.
6. Be displayed when concentrations of H<sub>2</sub>S reach 20 ppm.

**Red Flags shall:**

1. Be visible to aircraft and watercraft when hoisted.
2. Be a minimum width of 3 feet and a minimum height of 2 feet.
3. Be illuminated at night and under conditions of poor visibility, and
4. Be displayed when concentrations of H<sub>2</sub>S reach 50 ppm.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if:

1. Signs or flags are not displayed as required.
2. Signs or flags are not available for use.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-120**

**DOES THE FACILITY HAVE AN H<sub>2</sub>S-DETECTION AND H<sub>2</sub>S-MONITORING SYSTEM WHICH IS CAPABLE OF SENSING A MINIMUM OF 10 PPM H<sub>2</sub>S AND WHICH ACTIVATES AUDIBLE AND VISUAL ALARMS WHEN THE ATMOSPHERIC CONCENTRATION REACHES 20 PPM AND ARE THESE SENSING DEVICES LOCATED AT THE BELL NIPPLE, MUD RETURN LINE RECEIVER TANK (POSSUM BELLY), PIPE TRIP TANK, SHALE SHAKER, WELL-CONTROL FLUID PIT AREA, DRILLER'S STATION, LIVING QUARTERS, AND OTHER AREAS WHERE H<sub>2</sub>S MIGHT ACCUMULATE?**

**Authority: 490(j)(1)(i)**

**Enforcement Action: S**

**490(j)(2)(i)**

**490(j)(2)(ii)**

**490(j)(2)(iii)**

**490(j)(2)(iv)**

**490(j)(2)(v)**

**490(j)(2)(vi)**

**490(j)(2)(vii)**

**490(j)(2)(viii)**

**INSPECTION PROCEDURE:**

1. Visually verify that detection and monitoring equipment (sensors) is installed at:  
A. Bell nipple.

- B. Mud return line receiver tank (possum belly).
  - C. Pipe trip tank.
  - D. Shale shaker.
  - E. Well-control fluid pit area.
  - F. Driller's station.
  - G. Living quarters (drilling personnel).
  - H. Other areas where H<sub>2</sub>S may accumulate.
2. Have Shell test equipment for operation.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if H<sub>2</sub>S detection and monitoring equipment is not:

- 1. Installed at the required locations.
- 2. Operable.

**INSPECTION FORM:**

Enter one item checked for each location inspected.

**H-121****ARE SENSORS LOCATED IN ROOMS, BUILDINGS, DECK AREAS, OR LOW-LAYING DECK AREAS NOT OTHERWISE COVERED BY 30 CFR 250.490(j)?**

**Authority:** 490(j)(5)(i)

**Enforcement Action:** S

**INSPECTION PROCEDURE:**

Verify that sensors are located in rooms, buildings, deck areas, or low-laying deck areas not otherwise covered by 30 CFR 250.490(j).

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if sensors are not located in rooms, buildings, deck areas, or low-laying deck areas not otherwise covered by 30 CFR 250.490(j).

**INSPECTION FORM:**

Enter one item checked for each location inspected.

**H-122****IS AT LEAST ONE SENSOR INSTALLED PER 400 SQUARE FEET OF DECK AREA OR FRACTIONAL PART THEREOF (OR AS OTHERWISE APPROVED BY THE DISTRICT SUPERVISOR)?**

**Authority:** 490(j)(5)(i)

**Enforcement Action:** S

**INSPECTION PROCEDURE:**

Verify that there is at least one sensor installed per 400 square feet of deck area or fractional part thereof (or as otherwise approved by the District Supervisor).

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if there is not at least one sensor installed per 400 square feet of deck area or a fractional part thereof (or as otherwise approved by the District Supervisor).

**INSPECTION FORM:**

Enter one item checked for each area inspected.

**H-123**

**IS A SENSOR LOCATED IN BUILDINGS WHERE PERSONNEL HAVE THEIR LIVING QUARTERS?**

**Authority: 490(j)(5)(ii)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Verify that a sensor is located in buildings where personnel have their living quarters.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if there is not a sensor located in buildings where personnel have their living quarters.

**INSPECTION FORM:**

Enter one item checked for each building inspected.

**H-124**

**IS ONE SENSOR LOCATED WITHIN 10 FEET OF EACH VESSEL, COMPRESSOR, WELLHEAD, MANIFOLD, OR PUMP (OR AS OTHERWISE APPROVED BY THE DISTRICT SUPERVISOR)?**

**Authority: 490(j)(5)(iii)**

**Enforcement Action: C**

**INSPECTION PROCEDURE:**

Inspect to verify that there is one sensor located within 10 feet of each vessel, compressor, wellhead, manifold, or pump (or as otherwise approved by the District Supervisor).

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC if a sensor is not located within 10 feet of each vessel, compressor, wellhead, manifold, or pump (or as otherwise approved by the District Supervisor).

**INSPECTION FORM:**

Enter one item checked for each component inspected.

**H-125**

**IF ONE SENSOR IS USED TO COVER MULTIPLE PIECES OF EQUIPMENT, IS EACH PIECE OF EQUIPMENT NO MORE THAN 10 FEET FROM THE SENSOR (OR AS OTHERWISE APPROVED BY THE DISTRICT SUPERVISOR)?**

**Authority: 490(j)(5)(iv)**

**Enforcement Action: C**

**INSPECTION PROCEDURE:**

Verify that if one sensor is used to cover multiple pieces of equipment, each piece of equipment is no more than 10 feet from the sensor (or as otherwise approved by the District Supervisor).

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC if pieces of the equipment are more than 10 feet from the sensor (or as otherwise approved by the District Supervisor).

**INSPECTION FORM:**

Enter one item checked for multiple pieces of equipment inspected.

**H-126**

**IS THE H<sub>2</sub>S-DETECTION SYSTEM RECALIBRATED WHEN FUNCTIONAL TESTS ARE NOT WITHIN 2 PPM OR 10 PERCENT, WHICHEVER IS GREATER, OF THE APPLIED CONCENTRATIONS (OR AS OTHERWISE APPROVED BY THE DISTRICT SUPERVISOR)?**

**Authority: 490(j)(6)(ii)**

**Enforcement Action: C**



**INSPECTION PROCEDURE:**

Check Shell's records to verify that the H<sub>2</sub>S-detection and H<sub>2</sub>S-monitoring equipment is recalibrated as required (or as otherwise approved by the District Supervisor).

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC on the monitored area if the H<sub>2</sub>S-detection and H<sub>2</sub>S-monitoring equipment has not been recalibrated as required (or as otherwise approved by the District Supervisor).

**INSPECTION FORM:**

Enter one item checked per facility.

**H-127****ARE PORTABLE H<sub>2</sub>S DETECTORS CAPABLE OF DETECTING 10 PPM CONCENTRATIONS OF****H<sub>2</sub>S GAS IN AIR AND AVAILABLE FOR USE BY ALL PERSONNEL?**

**Authority: 490(k)(1)(i)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Verify that portable H<sub>2</sub>S detectors capable of detecting 10 ppm concentrations of H<sub>2</sub>S gas in air are available for use by all personnel.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if portable H<sub>2</sub>S detectors are not capable of detecting 10 ppm concentrations of H<sub>2</sub>S gas in air and available for use by all personnel.

**INSPECTION FORM:**

Enter one item checked for each portable detector checked.

**H-128****ARE PRESSURE-DEMAND TYPE RESPIRATORS WITH HOSELINE CAPABILITY AND BREATHING TIME OF AT LEAST 15 MINUTES IMMEDIATELY AVAILABLE AND EASILY ACCESSIBLE TO ALL PERSONNEL ON THE FACILITY INCONFORMANCE WITH ANSI Z88.2?**

**Authority: 490(j)(13)(i)**

**Enforcement Action: S**

**490(j)(13)(ii)**

**490(j)(13)(v)**

**INSPECTION PROCEDURE:**

1. Inspect the facility to verify that all pressure-demand type respirators with hoseline capability and breathing time of at least 15 minutes are available and easily accessible to all personnel on the facility and in conformance with ANSI Z88.2.

2. Visually inspect gauges to verify that the air tanks are full.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (S) INC if all pressure-demand type respirators with hoseline capability of at least 15 minutes of breathing time are not accessible to all personnel on the facility and in conformance with ANSI Z88.2.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-129****ARE AT LEAST TWO VOICE TRANSMISSION DEVICES, WHICH CAN BE USED WHILE WEARING A RESPIRATOR, AVAILABLE FOR USE BY DESIGNATED PERSONNEL?**

**Authority: 490(j)(13)(iii)****Enforcement Action: W****INSPECTION PROCEDURE:**

Verify that at least two voice transmission devices, which can be used while wearing a respirator, are available for use by designated personnel.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if there are not at least two voice transmission devices on the facility.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-131****IS EACH BREATHING-AIR BOTTLE LABELED AS CONTAINING BREATHING-QUALITY AIR FOR HUMAN USE?****Authority: 490(j)(13)(vi)****Enforcement Action: C/S****INSPECTION PROCEDURE:**

Visually inspect the breathing-air bottles to verify that they are labeled as containing breathing-quality air for human use.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC if a few of the breathing-air bottles are not labeled as containing breathing-quality air for human use but have ample supply of bottles that are labeled.

Issue a facility shut-in (**S**) INC if none of the breathing-air bottles are labeled as containing breathing-quality air for human use.

**INSPECTION FORM:**

Enter one item checked for each bottle inspected.

**H-132****DO VESSELS ATTENDANT TO FACILITIES CARRY APPROPRIATE PROTECTIVE-BREATHING EQUIPMENT FOR EACH CREW MEMBER?****Authority: 490(j)(13)(vii)****Enforcement Action: C****INSPECTION PROCEDURE:**

1. If conditions permit, inspect each attendant vessel to verify that it carries sufficient protective-breathing equipment for each crew member.
2. If the District Supervisor has required additional protective-breathing equipment for vessels, verify that the additional equipment is on board.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC to remove the vessel if:

1. The vessel does not carry sufficient protective-breathing equipment for each crew member.
2. The vessel does not carry the additional equipment required by the District Supervisor.

**INSPECTION FORM:**

Enter one item checked for each vessel inspected.

**H-133****FOR AUTHORIZED FLIGHTS DURING H<sub>2</sub>S ALERTS, ARE HELICOPTER FLIGHTS TO AND FROM THE FACILITY LIMITED TO THE CONDITIONS SPECIFIED IN THE H<sub>2</sub>S CONTINGENCY PLAN?**

**Authority: 490(j)(13)(viii)****Enforcement Action: C****INSPECTION PROCEDURE:**

Review contingency plans to determine when a flight is considered an authorized flight.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC if unauthorized flights are witnessed during an H<sub>2</sub>S alert.

**INSPECTION FORM:**

Enter one item checked for each unauthorized flight.

**H-134****DURING AUTHORIZED FLIGHTS, DO THE FLIGHT CREW AND PASSENGERS USE PRESSURE-DEMAND TYPE RESPIRATORS?****Authority: 490(j)(13)(viii)****Enforcement Action: C****INSPECTION PROCEDURE:**

During an authorized H<sub>2</sub>S alert flight, observe if the flight crew and passengers use pressure-demand type respirators.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC if the crew and passengers are not using pressure-demand type respirators.

**INSPECTION FORM:**

Enter one item for each crew member and passenger inspected.

**H-135****ARE ALL MEMBERS OF THE FLIGHT CREW TRAINED IN THE USE OF THE PARTICULAR TYPE(S) OF RESPIRATOR EQUIPMENT MADE AVAILABLE?****Authority: 490(j)(13)(viii)****Enforcement Action: C****INSPECTION PROCEDURE:**

Verify that all members of the flight crew have been trained in the use of the particular type equipment aboard the aircraft or stored at the heliport.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC to remove the helicopter if all members of the flight crew have not been trained in the use of the equipment.

**INSPECTION FORM:**

Enter one item checked for each flight crew inspected.

**H-136****AS APPROPRIATE TO THE PARTICULAR OPERATION(S), (PRODUCTION, DRILLING, WELL-COMPLETION/WORKOVER, OR ANY COMBINATION THEREOF), IS A SYSTEM OF BREATHING-AIR MANIFOLDS, HOSES, AND MASKS PROVIDED ON THE FACILITY AND IN THE BRIEFING AREAS?****Authority: 490(j)(13)(ix)****Enforcement Action: S****INSPECTION PROCEDURE:**

Visually inspect the facility, including the briefing areas, to verify that a system of breathing-air manifolds, hoses, and masks has been installed as approved in the H<sub>2</sub>S Contingency Plan.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if a system of breathing-air manifolds, hoses, and masks has not been installed as approved in the H<sub>2</sub>S Contingency Plan.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-137**

**IS A CASCADE AIR-BOTTLE SYSTEM PROVIDED FOR THE BREATHING-AIR MANIFOLDS AND TO REFILL INDIVIDUAL PROTECTIVE-BREATHING APPARATUS BOTTLES?**

**Authority: 490(j)(13)(ix)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that the cascade air-bottle system has been installed as approved in the H<sub>2</sub>S Contingency Plan.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if a cascade air-bottle system has not been installed as approved in the H<sub>2</sub>S Contingency Plan.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-138**

**IF THE CASCADE AIR-BOTTLE SYSTEM IS RECHARGED BY A HIGH-PRESSURE COMPRESSOR SUITABLE FOR PROVIDING BREATHING-QUALITY AIR, IS THE COMPRESSOR SUCTION LOCATED IN AN UNCONTAMINATED ATMOSPHERE?**

**Authority: 490(j)(13)(ix)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Visually inspect the compressor to verify that:

1. It is suitable for providing breathing-quality air.
2. The compressor suction is located in an uncontaminated atmosphere.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if:

1. The high-pressure compressor is not suitable for providing breathing-quality air, or
2. The compressor suction is located in a contaminated atmosphere.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-140**

**ARE RETRIEVAL ROPES WITH SAFETY HARNESSSES AVAILABLE TO RETRIEVE INCAPACITATED PERSONNEL FROM CONTAMINATED AREAS?**

**Authority: 490(k)(1)(ii)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that retrieval ropes with safety harnesses are available as approved in the H<sub>2</sub>S Contingency Plan.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if retrieval ropes with safety harnesses are not available.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-141**

**ARE CHALKBOARDS AND/OR NOTE PADS AVAILABLE FOR COMMUNICATION PURPOSES LOCATED ON THE RIG FLOOR, SHALE-SHAKER AREA, THE CEMENT-PUMP ROOMS, WELL-BAY AREAS, PRODUCTION PROCESSING EQUIPMENT AREA, GAS COMPRESSOR AREA, AND PIPELINE-PUMP AREA?**

**Authority: 490(k)(1)(iii)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually inspect to verify that chalkboards and/or note pads are available at the following locations as approved in the H<sub>2</sub>S Contingency Plan:

1. Rig floor.
2. Shale-shaker area.
3. Cement-pump rooms.
4. Well-bay areas.
5. Production processing equipment area.
6. Gas compressor area.
7. Pipeline-pump area.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if chalkboards and/or note pads are not available at the required locations.

**INSPECTION FORM:**

Enter one item checked for each location inspected.

**H-142**

**ARE BULL HORNS AND FLASHING LIGHTS AVAILABLE?**

**Authority: 490(k)(1)(iv)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that the following equipment is available and operable as approved in the H<sub>2</sub>S Contingency Plan:

Bull horns.

Flashing lights.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if operable bull horns and flashing lights are not available.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-143**

**ARE AUDIBLE ALARMS AND DISPLAY FLAGS OR FLASHING RED LIGHTS AVAILABLE FOR USE ON FACILITIES WHEN ATMOSPHERIC CONCENTRATIONS OF H<sub>2</sub>S REACH 20 PPM AND ARE SIGNS AND FLAGS CAPABLE OF BEING ILLUMINATED AT NIGHT AND UNDER CONDITIONS OF POOR VISIBILITY?**

**Authority: 490(i)(2)(ii)**

**Enforcement Action: S**

**490(i)(5)**

**490(i)(7)(i)**

**INSPECTION PROCEDURE:**

Test and visually inspect:

1. Audible alarms
2. Display flags or flashing red lights
3. Signs and flags capable of being illuminated at night and under conditions of poor visibility.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the above items are not available for use on the facility.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-144****ARE ALL VENTILATION DEVICES EXPLOSION-PROOF AND SITUATED IN AREAS WHERE H<sub>2</sub>S OR SO<sub>2</sub> MAY ACCUMULATE?**

**Authority: 490(k)(2)(i)**

**Enforcement Action: C/S**

**490(k)(2)(ii)**

**INSPECTION PROCEDURE:**

1. Visually inspect all ventilation devices to verify that they are explosion-proof.
2. Visually inspect the facility to verify that ventilation devices are situated in areas where H<sub>2</sub>S and SO<sub>2</sub> may accumulate as approved in the H<sub>2</sub>S Contingency Plan.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC for the ventilation device if it is not explosion-proof.

Issue a facility shut-in (**S**) INC if ventilation devices are not situated as approved in the H<sub>2</sub>S Contingency Plan in areas where H<sub>2</sub>S and SO<sub>2</sub> may accumulate.

**INSPECTION FORM:**

Enter one item checked for each device inspected.

**H-145****ARE MOVABLE, MULTIDIRECTIONAL VENTILATION DEVICES CAPABLE OF DISPERSING H<sub>2</sub>S OR SO<sub>2</sub> VAPORS AWAY FROM WORKING PERSONNEL PROVIDED IN WORK AREAS?**

**Authority: 490(k)(2)(iii)**

**Enforcement Action: C**

**INSPECTION PROCEDURE:**

Visually inspect work areas to verify that movable, multidirectional ventilation devices capable of dispersing H<sub>2</sub>S and SO<sub>2</sub> vapors are provided.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC for the work area if movable, multidirectional ventilation devices capable of dispersing H<sub>2</sub>S and SO<sub>2</sub> vapors are not provided.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-146****IF WATER-BASED, WELL-CONTROL FLUIDS ARE USED, AND IF H<sub>2</sub>S IS DETECTED BY AIR SENSORS, HAS THE GARRETT-GAS-TRAIN TEST OR COMPARABLE TEST TECHNIQUES FOR SOLUBLE SULFIDES BEEN CONDUCTED?**

**Authority: 490(m)(2)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that the Garrett-Gas-Train test or comparable test for soluble sulfides has been conducted if H<sub>2</sub>S was detected when using water-base well-control fluids.

2. If the concentration detected by air sensors is in excess of 20 ppm, personnel conducting the tests shall don protective-breathing equipment.

**Note:** The Garrett-Gas-Train test is described in API RP 13B, Appendix A.16.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if the Garrett-Gas-Train test or comparable test for soluble sulfides has not been conducted when H<sub>2</sub>S was detected.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-147**

**ARE SUFFICIENT QUANTITIES OF ADDITIVES (SCAVENGERS, pH, AND CORROSION CONTROL) MAINTAINED ON THE FACILITY?**

**Authority:** 490(m)(4)(i)

**Enforcement Action:** S

490(m)(4)(ii)

490(m)(4)(iii)

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that sufficient quantities of additives as approved in the H<sub>2</sub>S Contingency Plan are available for the:

1. Control of H<sub>2</sub>S (scavengers).
2. Control of well-control fluid pH.
3. Control for corrosion of equipment.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if sufficient quantities of additives are not available to control:

1. H<sub>2</sub>S.
2. Well-control fluid pH.
3. Corrosion of equipment.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-148 WHEN**

**H<sub>2</sub>S IS DETECTED, IS DRILLING SUSPENDED UNTIL SCAVENGER IS CIRCULATED THROUGHOUT THE SYSTEM?**

**Authority:** 490(m)(4)(i)

**Enforcement Action:** S

**INSPECTION PROCEDURE:**

If present on the facility during the detection of H<sub>2</sub>S, observe to see if drilling is suspended until scavenger is circulated throughout system.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if drilling is not suspended and scavenger is not circulated throughout the system.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-149**

**IS THE pH OF WATER-BASED WELL-CONTROL FLUIDS MAINTAINED AT A MINIMUM OF 10.0?**

**Authority: 490(m)(4)(ii)****Enforcement Action: S****INSPECTION PROCEDURE:**

Check the Shell's records to verify that the pH of water-based well-control fluids is maintained at a minimum of 10.0.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the pH of well-control fluids is not maintained at a minimum of 10.0.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-150****ARE WELL-CONTROL FLUIDS CONTAINING H<sub>2</sub>S DEGASSED AT THE OPTIMUM LOCATION FOR THE PARTICULAR FACILITY AND ARE THE GASSES REMOVED BURNED IN A CLOSED FLARE SYSTEM?****Authority: 490(m)(5)****Enforcement Action: S****INSPECTION PROCEDURE:**

1. Review H<sub>2</sub>S Contingency Plan to ascertain optimum location for degasser.
2. Visually inspect the facility to confirm the presence of the degasser and that it is operative.
3. Visually inspect the flare system to verify that it is a closed system.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the degasser is not operative or if flare system is not a closed system.

**INSPECTION FORM:**

Enter one item checked for each flare system inspected.

**H-151****IS A SAFETY MEETING CONDUCTED FOR ALL PERSONNEL WHO WILL BE ON THE FACILITY PRIOR TO WELL TESTING?****Authority: 490(o)(1)****Enforcement Action: C****INSPECTION PROCEDURE:**

Check Shell's records to verify that a safety meeting was held for all personnel prior to well testing operations.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC for well testing operations if a safety meeting for all personnel was not conducted prior to commencing well testing.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-152****ARE ALL GASES PRODUCED DURING TESTING BURNED THROUGH A FLARE SYSTEM WHICH MEETS THE REQUIREMENTS OF 30 CFR 490(o)(3)?****Authority: 490(o)(3)****Enforcement Action: S****INSPECTION PROCEDURE:**



Visually inspect the well testing operation and equipment to verify that all gases produced during testing will be routed to the flare system and burned as prescribed by the requirements of 30 CFR 490(o)(3).

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the gases produced during well testing are not routed into the flare system and burned as per the requirements of 30 CFR 490(o)(3).

**INSPECTION FORM:**

Enter one item checked per facility.

**H-153**

**ARE FLARE LINE OUTLETS LOCATED ON THE DOWNWIND SIDE AND AS FAR FROM THE FACILITY AS IS FEASIBLE?**

**Authority: 490(q)(6)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that the flare line outlets are located:

1. On the downwind side of the facility.
2. As far from the facility as is feasible.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the flare line outlets are not located as required.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-154**

**IS THE FLARE OUTLET EQUIPPED WITH AN AUTOMATIC IGNITION SYSTEM INCLUDING A PILOT-LIGHT GAS SOURCE OR AN EQUIVALENT SYSTEM?**

**Authority: 490(q)(6)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Visually inspect the flare system to verify that it is equipped with an automatic ignition system including a pilot-light gas source or an equivalent system.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the flare system is not equipped with an automatic ignition system including a pilot-light gas source or an equivalent system.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-155**

**IS AN ALTERNATE METHOD AVAILABLE FOR IGNITING THE FLARE?**

**Authority: 490(q)(6)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Visually inspect the flare system to verify that an alternate method of ignition is provided.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if an alternate method of igniting the flare is not provided.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-156**

**ARE ALL VENTS USED FOR H<sub>2</sub>S PRODUCTION PROCESS EQUIPMENT, TANKS, RELIEF VALVES, BURST PLATES, AND SIMILAR DEVICES PIPED TO THE FLARE SYSTEM?**

**Authority: 490(q)(6)**

**Enforcement Action: C/S**

**INSPECTION PROCEDURE:**

Visually inspect the facility to verify that all vents are piped to the flare system used for H<sub>2</sub>S for:

1. Production process equipment.
2. Tanks.
3. Relief valves.
4. Burst plates.
5. Similar devices.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (**C**) INC if certain components are not vented properly.

Issue a facility shut-in (**S**) INC if all components on the facility are not vented properly.

**INSPECTION FORM:**

Enter one item checked per component inspected.

**H-157**

**IS GAS CONTAINING H<sub>2</sub>S NOT USED FOR INSTRUMENT GAS, AND IF H<sub>2</sub>S IS BEING USED AS FUEL GAS, DOES THE SHELL HAVE APPROVAL FROM THE DISTRICT SUPERVISOR?**

**Authority: 490(q)(9)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

1. Check Shell's records and inspect all instruments for any indication that gas containing H<sub>2</sub>S may be being used for instruments.
2. Check Shell's records and all combustion devices for indications that gas containing H<sub>2</sub>S may be used for fuel. The District Supervisor may approve the use of gas containing H<sub>2</sub>S for fuel. If no approval has been given and indications are present, Shell must prove that gas used for fuel does not contain H<sub>2</sub>S.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if gas containing H<sub>2</sub>S is used for instruments or if gas containing H<sub>2</sub>S is used for fuel without the prior approval of the District Supervisor.

**INSPECTION FORM:**

Enter one item checked for each facility.

**H-158**

**HAS THE DISTRICT SUPERVISOR BEEN NOTIFIED IF PRODUCED WATER IS DISPOSED OF BY MEANS OTHER THAN SUBSURFACE INJECTION?**

**Authority: 490(q)(12)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Inspect the production process system to verify that produced water to be disposed of by means other than subsurface injection is treated for removal of H<sub>2</sub>S.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if the produced water to be disposed of by means other than subsurface injection is not treated for removal of H<sub>2</sub>S and does not have approval by the District Supervisor.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-159****ARE H<sub>2</sub>S LEVELS CONTINUOUSLY MONITORED IN THE WORK AREAS DURING DRILLING, WELL-COMPLETION, AND WELL-WORKOVER OPERATIONS?**

**Authority: 490(j)(4)(i)**

**Enforcement Action: W/S**

**490(j)(4)(ii)**

**490(j)(4)(iii)**

**490(j)(4)(iv)**

**490(j)(4)(v)**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that H<sub>2</sub>S levels were monitored in the work area when:
  - A. Pulling a wet string of drill pipe;
  - B. Pulling a workover string;
  - C. Circulating bottoms-up after a drilling break;
  - D. Cementing;
  - E. Logging; and
  - F. Circulating to condition mud or other well-control fluids.
2. If present during such operations, verify that the required monitoring is being conducted.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that monitoring was not conducted during such operations.

Issue a facility shut-in (**S**) INC if such monitoring is not being conducted when present during such operations.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-160****WHEN CONDUCTING CORING OPERATIONS, IS PROTECTIVE BREATHING EQUIPMENT WORN BY ALL PERSONNEL IN THE WORK AREA AT LEAST 10 STANDS IN ADVANCE OF RETRIEVING THE CORE BARREL?**

**Authority: 490(q)(1)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that protective breathing equipment was worn by personnel in the work area at least 10 stands in advance of retrieving the core barrel during conventional coring operations.
2. If present during such operations, verify that protective breathing equipment is worn by personnel in the work area at least 10 stands in advance of retrieving the core barrel during conventional coring operations.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that protective breathing equipment was not worn by personnel in the work area at least 10 stands in advance of retrieving the core barrel during conventional coring operations.

Issue a facility shut-in (**S**) INC if protective breathing equipment is not worn by personnel in the work area at least 10 stands in advance of retrieving the core barrel during conventional coring operations, if present during such operations.

**INSPECTION FORMS:**

Enter one item checked per facility.

**H-161**

**ARE ALL CORES TO BE TRANSPORTED SEALED AND MARKED FOR THE PRESENCE OF H<sub>2</sub>S?**

**Authority: 490(q)(1)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that all cores to be transported were sealed and marked for the presence of H<sub>2</sub>S.
2. If present on the facility, inspect all cores to verify that they have been sealed and marked for the presence of H<sub>2</sub>S.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that cores were not sealed and marked for the presence of H<sub>2</sub>S.

Issue a facility shut-in (**S**) INC if cores are not sealed and marked for the presence of H<sub>2</sub>S if present on the facility during inspection.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-162**

**IS WELL-CONTROL FLUID IN USE FOR LOGGING OPERATIONS CONDITIONED AND TREATED TO MINIMIZE THE EFFECT OF H<sub>2</sub>S ON THE LOGGING EQUIPMENT?**

**Authority: 490(q)(2)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Inspect Shell's records to verify that well-control fluids in use during logging operations were conditioned and treated to minimize the effect of H<sub>2</sub>S on the logging equipment.
2. If present during logging operations, observe well-control fluid handling operations and check records to verify that the well-control fluids have been conditioned and treated to minimize the effect of H<sub>2</sub>S on the logging equipment.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that the well-control fluids in use during logging operations were not conditioned and treated to minimize the effect of H<sub>2</sub>S on the logging equipment.

Issue a facility shut-in (**S**) INC if present during logging operations and the well-control fluids have not been conditioned and treated to minimize the effect of H<sub>2</sub>S on the logging equipment.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-163**

**DURING STRIPPING OPERATIONS, ARE DISPLACED WELL-CONTROL FLUID RETURNS MONITORED BY PERSONNEL?**

**Authority: 490(q)(3)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that well-control fluid returns were monitored by personnel during stripping operations.
2. If present during stripping operations, observe well-control fluid returns for the presence of monitoring personnel.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that well-control fluid returns were not monitored by personnel during stripping operations.

Issue a facility shut-in (**S**) INC if present during stripping operations and well-control fluid returns are not monitored by personnel.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-164****DURING STRIPPING OPERATIONS, IS PROTECTIVE BREATHING EQUIPMENT WORN BY PERSONNEL IN THE WORK AREA WHEN THE ATMOSPHERIC CONCENTRATION OF H<sub>2</sub>S REACHES OR EXCEEDS 20 PPM OR IF THE WELL IS UNDER PRESSURE?**

**Authority: 490(q)(3)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that protective breathing equipment was worn by personnel in the work area during stripping operations when the concentration of H<sub>2</sub>S reached or exceeded 20 ppm, or if the well was under pressure.
2. If present during stripping operations and the concentration of H<sub>2</sub>S equals or exceeds 20 ppm, or if the well is under pressure, observe the work area to verify that personnel are wearing protective breathing equipment.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that personnel did not wear protective breathing equipment during stripping operations when the concentration of H<sub>2</sub>S reached or exceeded 20 ppm, or if the well was under pressure.

Issue a facility shut-in (**S**) INC if present during stripping operations and protective breathing equipment is not worn by personnel in the work area if the concentration of H<sub>2</sub>S reaches or exceeds 20 ppm, or if the well is under pressure.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-165****IS PROTECTIVE BREATHING EQUIPMENT WORN BY PERSONNEL IN THE WORK AREA DURING BOTTOMS-UP WHEN CIRCULATING OUT A KICK AND DURING EXTENDED KILL OPERATIONS?**

**Authority: 490(q)(4)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that protective breathing equipment was worn by personnel in the work area during bottoms-up when circulating out a kick and during extended kill operations.
2. If present during bottoms-up when circulating out a kick and during extended kill operations, observe the

work area to verify that personnel are wearing protective breathing equipment.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that personnel did not wear protective breathing equipment during bottoms-up when circulating out a kick and during extended kill operations.

Issue a facility shut-in (**S**) INC for the facility if present during bottoms-up when circulating out a kick and during extended kill operations if personnel in the work area are not wearing protective breathing equipment.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-166**

**IS AN EFFECTIVE MEANS OF MONITORING AND CONTROLLING CORROSION CAUSED BY ACID GASES USED IN BOTH THE DOWNHOLE AND SURFACE PORTIONS OF A PRODUCTION SYSTEM?**

**Authority: 490(q)(7)**

**Enforcement Action: S**

**INSPECTION PROCEDURE:**

Check Shell's records and observe production system for indications of corrosion monitoring and control equipment. The Shell must prove that such means for monitoring and controlling corrosion exist.

**IF NONCOMPLIANCE EXISTS:**

Issue a facility shut-in (**S**) INC if records and observations indicate that an effective means of monitoring and controlling corrosion in both the downhole and surface portions of the production system does not exist.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-167**

**ARE LUBRICATORS WHICH MAY BE EXPOSED TO FLUIDS CONTAINING H<sub>2</sub>S MADE OF H<sub>2</sub>S-RESISTANT MATERIALS?**

**Authority: 490(q)(8)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

1. Check Shell's records to verify that lubricators exposed to fluids containing H<sub>2</sub>S were made of H<sub>2</sub>S resistant materials.
2. If present when lubricators are installed, visually inspect the lubricator for make and model and verify with records that they are made of H<sub>2</sub>S resistant material.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if Shell's records indicate that lubricators exposed to fluids containing H<sub>2</sub>S were not made of H<sub>2</sub>S resistant material.

Issue a facility shut-in (**S**) INC if the lubricators which may be exposed to fluids containing H<sub>2</sub>S and in use during the inspection are not made of H<sub>2</sub>S resistant materials.

**INSPECTION FORM:**

Enter one item checked for each lubricator.

**H-168**

**ARE METALS USED FOR SENSING LINES AND SAFETY-CONTROL DEVICES WHICH ARE EXPOSED TO H<sub>2</sub>S BEARING FLUIDS CONSTRUCTED OF H<sub>2</sub>S CORROSION RESISTANT**

**MATERIALS OR COATED WITH APPROPRIATE MATERIALS SO AS TO RESIST CORROSION?****Authority: 490(q)(10)****Enforcement Action: W/S****INSPECTION PROCEDURE:**

1. Check Shell's records to verify that metals used in sensing lines and safety-control devices which were exposed to H<sub>2</sub>S bearing fluids were constructed with H<sub>2</sub>S corrosion resistant materials or coated with appropriate materials so as to resist corrosion.
2. If present on the facility during operations in a known H<sub>2</sub>S zone, verify that the metals and safety-control devices are properly constructed or coated.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if the metals were not properly constructed or coated so as to resist H<sub>2</sub>S corrosion.

Issue a facility shut-in (**S**) INC if present on the facility during operations in a known H<sub>2</sub>S bearing zone and the metals and safety-control devices are not properly constructed or coated.

**INSPECTION FORM:**

Enter one item checked per facility. .

**H-169****ARE ALL SEALS WHICH MAY BE EXPOSED TO FLUIDS CONTAINING H<sub>2</sub>S MADE OF H<sub>2</sub>S-RESISTANT MATERIAL?****Authority: 490(q)(11)****Enforcement Action: W/S****INSPECTION PROCEDURE:**

1. Inspect records to verify that all seals, which were in service while operating in a known H<sub>2</sub>S zone and which may have been exposed to fluids containing H<sub>2</sub>S, were made of H<sub>2</sub>S-resistant material.
2. If present while operations are conducted in a known H<sub>2</sub>S zone, verify that all seals, which may be exposed to fluids containing H<sub>2</sub>S, are made of H<sub>2</sub>S-resistant material by visual observation and records checks.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate that seals, which may have been exposed to fluids containing H<sub>2</sub>S, were not made of H<sub>2</sub>S-resistant material.

Issue a facility shut-in (**S**) INC if seals which may be exposed to fluids containing H<sub>2</sub>S are not constructed of H<sub>2</sub>S resistant material, if witnessed during operations in a known H<sub>2</sub>S zone.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-170****DO TRAINED EMPLOYEES OR CONTRACTORS TRANSFERRED FROM ANOTHER FACILITY RECEIVE A SUPPLEMENTAL BRIEFING ON H<sub>2</sub>S EQUIPMENT AND PROCEDURES BEFORE BEGINNING DUTY?****Authority: 490(g)(3)(i)****Enforcement Action: W****INSPECTION PROCEDURE:**

Verify that all Shell and contract personnel from other facilities have received a supplemental briefing on H<sub>2</sub>S equipment and procedures for this facility.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if any Shell or contract personnel have not received a supplemental briefing for this facility.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-171**

**DO VISITORS WHO REMAIN AT THE FACILITY FOR MORE THAN 24 HOURS RECEIVE THE TRAINING REQUIRED FOR EMPLOYEES AND CONTRACTORS?**

**Authority: 490(g)(3)(ii)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Verify that all visitors that will be on the facility for more than 24 hours have received the same training as required for the Shells and contractors.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if any visitors are on the facility more than 24 hours without receiving the same required training as the Shells and contractors.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-172**

**DO VISITORS WHO WILL DEPART THE FACILITY WITHIN 24 HOURS RECEIVE A BRIEFING ON H<sub>2</sub>S PROCEDURES?**

**Authority: 490(g)(3)(iii)**

**Enforcement Action: W**

**INSPECTION PROCEDURES:**

Verify that all visitors departing the facility within 24 hours have received a briefing on H<sub>2</sub>S procedures.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if records show any visitors departing the facility within 24 hours have not received the required briefing.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-173**

**ARE RECORDS OF ATTENDANCE IN DRILLS FOR DRILLING, WELL-COMPLETION, AND WELL-WORKOVER OPERATIONS MAINTAINED AT THE FACILITY UNTIL OPERATIONS ARE COMPLETED?**

**Authority: 490(h)(2)(i)**

**Enforcement Action: W**

**INSPECTION PROCEDURE:**

Verify that drill attendance records for drilling, well-completion, and well-workover operations are maintained on the facility until operations are completed.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if records for drills for drilling, well-completion, and well-workover operations are not being maintained at the facility.

**INSPECTION FORM:**

Enter one item checked per facility.



**H-174****ARE RECORDS OF ATTENDANCE IN DRILLS FOR PRODUCTION OPERATIONS MAINTAINED AT THE FACILITY OR THE NEAREST FIELD OFFICE FOR 1 YEAR?****Authority: 490(h)(2)(ii)****Enforcement Action: W****INSPECTION PROCEDURE:**

Verify that records of attendance in drills for production operations are maintained on the facility or the nearest field office for 1 year.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records of attendance in drills for production operations are not maintained at the facility or nearest field office for 1 year.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-175****ARE PORTABLE OR STRATEGICALLY PLACED FIXED SO<sub>2</sub> DEVICES CAPABLE OF DETECTING A MINIMUM OF 2 PPM OF SO<sub>2</sub> AVAILABLE OR IN USE AT THE FACILITY?****Authority: 490(j)(11)(i)****Enforcement Action: W/S****INSPECTION PROCEDURE:**

1. Verify that portable SO<sub>2</sub> devices are available on the facility.
2. Verify that strategically placed fixed SO<sub>2</sub> devices in use on the facility are capable of detecting a minimum of 2 ppm of SO<sub>2</sub>

**IF NONCOMPLIANCE EXISTS:**

1. Issue a warning (**W**) INC if portable SO<sub>2</sub> devices capable of detecting a minimum of 2 ppm of SO<sub>2</sub> are not available and flaring is not ongoing.
2. Issue a facility shut-in (**S**) INC if strategically placed fixed SO<sub>2</sub> devices are not available on the facility or not capable of detecting 2 ppm of SO<sub>2</sub> during flaring.

**INSPECTION FORM:**

Enter one item checked for each device inspected.

**H-176 ARE PORTABLE OR FIXED SO<sub>2</sub> ELECTRONIC SENSING DEVICES CALIBRATED EVERY 3 MONTHS?****Authority: 490(j)(11)(iv)****Enforcement Action: W/S****INSPECTION PROCEDURE:**

Verify that portable or fixed SO<sub>2</sub> electronic sensing devices have been calibrated every 3 months.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if records indicate a period was greater than 3 months between calibrations but subsequent calibrations were conducted within the required time period.  
Issue a facility shut-in (**S**) INC if inspection shows the last calibration occurred more than 3 months ago.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-177****ARE SPECTACLE KITS AVAILABLE FOR RESPIRATORS AS NEEDED?**

**Authority: 490(j)(13)(iv)****Enforcement Action: W****INSPECTION PROCEDURE:**

Inspect all respirators that require spectacle kits for specified personnel with vision problems.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC when spectacle kits in respirators are not issued to specified personnel.

**INSPECTION FORM:**

Enter one item checked per respirator inspected.

**H-178****ARE COMPRESSORS EXCEEDING 50 HP COVERED BY AT LEAST TWO H<sub>2</sub>S SENSORS LOCATED WITHIN 10 FEET OF THE COMPRESSOR?****Authority: 490(j)(5)(iv)****Enforcement Action: C****INSPECTION PROCEDURE:**

Verify that at least two H<sub>2</sub>S sensors are located within 10 feet of each compressor that exceeds 50 hp.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC if there are not at least two sensors located within 10 feet of any compressor that exceeds 50 hp.

**INSPECTION FORM:**

Enter one item checked per inspection.

**H-179****WHEN DRILLING, ARE FUNCTIONAL TESTS OF H<sub>2</sub>S DETECTORS INITIATED BEFORE THE BIT IS 1,500 FEET (VERTICALLY) ABOVE THE POTENTIAL H<sub>2</sub>S ZONE?****Authority: 490(j)(7)(i)****Enforcement Action: W****INSPECTION PROCEDURE:**

Inspect the driller's log to verify that functional tests are initiated before the bit is 1,500 feet (vertically) above the potential H<sub>2</sub>S zone.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (W) INC if functional tests are not initiated before the bit is 1,500 feet (vertically) above any potential H<sub>2</sub>S zone.

**INSPECTION FORM:**

Enter one item checked per inspection.

**H-180****WHEN CONDUCTING PRODUCTION OPERATIONS, ARE ALL H<sub>2</sub>S DETECTORS TESTED AT LEAST EVERY 14 DAYS?****Authority: 490(j)(7)(ii)****Enforcement Action: C****INSPECTION PROCEDURE:**

Verify that all H<sub>2</sub>S detectors are being tested at least every 14 days.

**IF NONCOMPLIANCE EXISTS:**

Issue a component shut-in (C) INC if records indicate that any H<sub>2</sub>S detector is not being tested at least every 14 days.

**INSPECTION FORM:**

Enter one item checked per facility.

**H-181**

**IN AREAS CLASSIFIED AS H<sub>2</sub>S PRESENT, ARE ALL H<sub>2</sub>S DETECTORS TESTED ONCE EVERY 24 HOURS WHEN CONDUCTING DRILLING OPERATIONS, DRILL STEM TESTING, WELL TESTING, WELL COMPLETION OPERATIONS, OR WORKOVER OPERATIONS?**

**Authority: 490(j)(7)(i)**

**Enforcement Action: W/S**

**INSPECTION PROCEDURE:**

Verify that all H<sub>2</sub>S detectors are being tested once every 24 hours.

**IF NONCOMPLIANCE EXISTS:**

Issue a warning (**W**) INC if each H<sub>2</sub>S detector is not tested within the 24-hour time period, but subsequent tests were conducted as required.

Issue a facility shut-in (**S**) INC if each H<sub>2</sub>S detector is not tested within the 24-hour time period and subsequent tests were not conducted.

**INSPECTION FORM:**

Enter one item checked per facility.

## **SECTION D-3**

### **29 CFR - CHAPTER XVII - PART 1910**

#### **THIS DATA CURRENT AS OF THE FEDERAL REGISTER DATED APRIL 25, 2003**

#### **§134. Respiratory protection**

This section applies to General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926).

(a) *Permissible practice.* (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program which shall include the requirements outlined in paragraph (c) of this section.

(b) *Definitions.* The following definitions are important terms used in the respiratory protection standard in this section.

*Air-purifying respirator* means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

*Assigned protection factor (APF)* [Reserved]

*Atmosphere-supplying respirator* means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

*Canister or cartridge* means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

*Demand respirator* means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

*Emergency situation* means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

*Employee exposure* means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

*End-of-service-life indicator (ESLI)* means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

*Escape-only respirator* means a respirator intended to be used only for emergency exit.

*Filter or air purifying element* means a component used in respirators to remove solid or liquid aerosols from the inspired air.

*Filtering facepiece* (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

*Fit factor* means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

*Fit test* means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

*Helmet* means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

*High efficiency particulate air (HEPA) filter* means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

*Hood* means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

*Immediately dangerous to life or health (IDLH)* means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

*Interior structural firefighting* means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)

*Loose-fitting facepiece* means a respiratory inlet covering that is designed to form a partial seal with the face.

*Maximum use concentration (MUC)* [Reserved].

*Negative pressure respirator (tight fitting)* means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

*Oxygen deficient atmosphere* means an atmosphere with an oxygen content below 19.5% by volume.

*Physician or other licensed health care professional (PLHCP)* means an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

*Positive pressure respirator* means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

*Powered air-purifying respirator (PAPR)* means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

*Pressure demand respirator* means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

*Qualitative fit test (QLFT)* means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

*Quantitative fit test (QNFT)* means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

*Respiratory inlet covering* means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

*Self-contained breathing apparatus (SCBA)* means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

*Service life* means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

*Supplied-air respirator (SAR) or airline respirator* means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

*This section* means this respiratory protection standard.

*Tight-fitting facepiece* means a respiratory inlet covering that forms a complete seal with the face.

*User seal check* means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

(c) *Respiratory protection program.* This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent

potential hazards associated with the use of the respirator. The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

- (i) Procedures for selecting respirators for use in the workplace;
- (ii) Medical evaluations of employees required to use respirators;
- (iii) Fit testing procedures for tight-fitting respirators;
- (iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;
- (v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;
- (vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;
- (vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;
- (viii) Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and
- (ix) Procedures for regularly evaluating the effectiveness of the program.

(2) Where respirator use is not required:

- (i) An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section ("Information for Employees Using Respirators When Not Required Under the Standard"); and
- (ii) In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is

cleaned, stored, and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

(3) The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

(4) The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

(d) *Selection of respirators.* This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

(1) *General requirements.* (i) The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

(ii) The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

(iii) The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

(iv) The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

(2) *Respirators for IDLH atmospheres.* (i) The employer shall provide the following respirators for employee use in IDLH atmospheres:

(A) A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

(B) A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

(ii) Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

(iii) All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen



concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

(3) *Respirators for atmospheres that are not IDLH.* (i) The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

(A) *Assigned Protection Factors (APFs)* [Reserved]

(B) *Maximum Use Concentration (MUC)* [Reserved]

(ii) The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

(iii) For protection against gases and vapors, the employer shall provide:

(A) An atmosphere-supplying respirator, or

(B) An air-purifying respirator, provided that:

( 1 ) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

( 2 ) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data.

(iv) For protection against particulates, the employer shall provide:

(A) An atmosphere-supplying respirator; or

(B) An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

(C) For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

Table I\_Assigned Protection Factors [Reserved]

Table II

Oxygen deficient Atmospheres (% O <sub>2</sub> ) for Altitude (ft.) which the employer may rely on atmosphere-supplying respirators	
Less than 3,001.....	16.0-19.5
3,001-4,000.....	16.4-19.5
4,001-5,000.....	17.1-19.5
5,001-6,000.....	17.8-19.5
6,001-7,000.....	18.5-19.5
7,001-8,000 <sup>1</sup> .....	19.3-19.5.

<sup>1</sup>Above 8,000 feet the exception does not apply.  
Oxygen-enriched breathing air must be supplied above  
14,000 feet.

(e) *Medical evaluation.* Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.

(1) *General.* The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

(2) *Medical evaluation procedures.* (i) The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

(ii) The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

(3) *Follow-up medical examination.* (i) The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question

among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

(ii) The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

(4) *Administration of the medical questionnaire and examinations.* (i) The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

(ii) The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

(5) *Supplemental information for the PLHCP.* (i) The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

(A) The type and weight of the respirator to be used by the employee;

(B) The duration and frequency of respirator use (including use for rescue and escape);

(C) The expected physical work effort;

(D) Additional protective clothing and equipment to be worn; and

(E) Temperature and humidity extremes that may be encountered.

(ii) Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

(iii) The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

#### **Note to paragraph**

(e)(5)(iii): When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

(6) *Medical determination.* In determining the employee's ability to use a respirator, the employer shall:

(i) Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:

(A) Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

(B) The need, if any, for follow-up medical evaluations; and

(C) A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

(ii) If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

(7) *Additional medical evaluations.* At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

(i) An employee reports medical signs or symptoms that are related to ability to use a respirator;

(ii) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

(iii) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

(iv) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

(f) *Fit testing.* This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

(1) The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

(2) The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

(3) The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

(4) If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

(5) The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

(6) QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

(7) If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

(8) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

(i) Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

(ii) Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

(iii) Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

(g) *Use of respirators.* This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

(1) *Facepiece seal protection.* (i) The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

(A) Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

(B) Any condition that interferes with the face-to-facepiece seal or valve function.

(ii) If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

(iii) For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B-1 of this section.

(2) *Continuing respirator effectiveness.* (i) Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

(ii) The employer shall ensure that employees leave the respirator use area:

(A) To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or

(B) If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or

(C) To replace the respirator or the filter, cartridge, or canister elements.

(iii) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.

(3) *Procedures for IDLH atmospheres.* For all IDLH atmospheres, the employer shall ensure that:

- (i) One employee or, when needed, more than one employee is located outside the IDLH atmosphere;
  - (ii) Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;
  - (iii) The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;
  - (iv) The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;
  - (v) The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;
  - (vi) Employee(s) located outside the IDLH atmospheres are equipped with:
    - (A) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
    - (B) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
    - (C) Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).
- (4) *Procedures for interior structural firefighting.* In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:
- (i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;
  - (ii) At least two employees are located outside the IDLH atmosphere; and
  - (iii) All employees engaged in interior structural firefighting use SCBAs.

**Note 1 to paragraph**

(g): One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

**Note 2 to paragraph**

(g): Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

(h) *Maintenance and care of respirators.* This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

(1) *Cleaning and disinfecting.* The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

(i) Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

(ii) Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

(iii) Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

(iv) Respirators used in fit testing and training shall be cleaned and disinfected after each use.

(2) *Storage.* The employer shall ensure that respirators are stored as follows:

(i) All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

(ii) In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

(A) Kept accessible to the work area;

(B) Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

(C) Stored in accordance with any applicable manufacturer instructions.

(3) *Inspection.* (i) The employer shall ensure that respirators are inspected as follows:

(A) All respirators used in routine situations shall be inspected before each use and during cleaning;



(B) All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

(C) Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

(ii) The employer shall ensure that respirator inspections include the following:

(A) A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and

(B) A check of elastomeric parts for pliability and signs of deterioration.

(iii) In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

(iv) For respirators maintained for emergency use, the employer shall:

(A) Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

(B) Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

(4) *Repairs.* The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

(i) Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

(ii) Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

(iii) Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

(i) *Breathing air quality and use.* This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

(1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

(i) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

(ii) Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

(A) Oxygen content (v/v) of 19.5-23.5%;

(B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

(C) Carbon monoxide (CO) content of 10 ppm or less;

(D) Carbon dioxide content of 1,000 ppm or less; and

(E) Lack of noticeable odor.

(2) The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

(3) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

(4) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

(i) Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 173 and part 178);

(ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

(iii) The moisture content in the cylinder does not exceed a dew point of -50 °F (-45.6 °C) at 1 atmosphere pressure.

(5) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

(i) Prevent entry of contaminated air into the air-supply system;

(ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 °C) below the ambient temperature;

(iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

(iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

(6) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

(7) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

(8) The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

(9) The employer shall use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

(j) *Identification of filters, cartridges, and canisters.* The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

(k) *Training and information.* This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

(1) The employer shall ensure that each employee can demonstrate knowledge of at least the following:

(i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

(ii) What the limitations and capabilities of the respirator are;

(iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

(iv) How to inspect, put on and remove, use, and check the seals of the respirator;

- (v) What the procedures are for maintenance and storage of the respirator;
- (vi) How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- (vii) The general requirements of this section.

(2) The training shall be conducted in a manner that is understandable to the employee.

(3) The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

(4) An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.

(5) Retraining shall be administered annually, and when the following situations occur:

- (i) Changes in the workplace or the type of respirator render previous training obsolete;
- (ii) Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or
- (iii) Any other situation arises in which retraining appears necessary to ensure safe respirator use.

(6) The basic advisory information on respirators, as presented in Appendix D of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

(l) *Program evaluation.* This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

(1) The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

(2) The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

- (i) Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- (ii) Appropriate respirator selection for the hazards to which the employee is exposed;
- (iii) Proper respirator use under the workplace conditions the employee encounters;  
and
- (iv) Proper respirator maintenance.

(m) *Recordkeeping.* This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

(1) *Medical evaluation.* Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.1020.

(2) *Fit testing.* (i) The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

- (A) The name or identification of the employee tested;
- (B) Type of fit test performed;
- (C) Specific make, model, style, and size of respirator tested;
- (D) Date of test; and
- (E) The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

(ii) Fit test records shall be retained for respirator users until the next fit test is administered.

(3) A written copy of the current respirator program shall be retained by the employer.

(4) Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

(n) *Dates -- (1) Effective date.* This section is effective April 8, 1998. The obligations imposed by this section commence on the effective date unless otherwise noted in this paragraph. Compliance with obligations that do not commence on the effective date shall occur no later than the applicable start-up date.

(2) *Compliance dates.* All obligations of this section commence on the effective date except as follows:

(i) The determination that respirator use is required (paragraph (a)) shall be completed no later than September 8, 1998.

(ii) Compliance with provisions of this section for all other provisions shall be completed no later than October 5, 1998.

(3) The provisions of 29 CFR 1910.134 and 29 CFR 1926.103, contained in the 29 CFR parts 1900 to 1910.99 and the 29 CFR part 1926 editions, revised as of July 1, 1997, are in effect and enforceable until October 5, 1998, or during any administrative or judicial stay of the provisions of this section.

(4) *Existing respiratory protection programs.* If, in the 12 month period preceding April 8, 1998, the employer has conducted annual respirator training, fit testing, respirator program evaluation, or medical evaluations, the employer may use the results of those activities to comply with the corresponding provisions of this section, providing that these activities were conducted in a manner that meets the requirements of this section.

(o) *Appendices.* (1) Compliance with Appendix A, Appendix B-1, Appendix B-2, and Appendix C of this section is mandatory.

(2) Appendix D of this section is non-mandatory and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

## APPENDIX A TO §1910.134 -- FIT TESTING PROCEDURES (MANDATORY)

### Part I. OSHA-Accepted Fit Test Protocols

#### A. Fit Testing Procedures -- General Requirements

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.

5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

(a) Position of the mask on the nose

(b) Room for eye protection

(c) Room to talk

(d) Position of mask on face and cheeks

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

(a) Chin properly placed;

(b) Adequate strap tension, not overly tightened;

(c) Fit across nose bridge;

(d) Respirator of proper size to span distance from nose to chin;

(e) Tendency of respirator to slip;

(f) Self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B-1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in Appendix B-1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.

11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.

12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.

14. Test Exercises. (a) The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP protocol. The test subject shall perform exercises, in the test environment, in the following manner:

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.



## Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)

(7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.

(8) Normal breathing. Same as exercise (1).

(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

## B. Qualitative Fit Test (QLFT) Protocols

### 1. General

(a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

### 2. Isoamyl Acetate Protocol

#### Note:

This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

### **(a) Odor Threshold Screening**

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

- (1) Three 1 liter glass jars with metal lids are required.
- (2) Odor-free water (e.g., distilled or spring water) at approximately 25 °C (77 °F) shall be used for the solutions.
- (3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly.
- (4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.
- (5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.
- (6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.
- (7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.
- (8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."
- (9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.
- (10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.
- (11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

**(b) Isoamyl Acetate Fit Test**

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

### 3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste threshold screening. The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

**Note to paragraph 3.**

(a): If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes

required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(12) Since the nebulizer has a tendency to clog during use, the test Shell must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

#### **4. Bitrex™ (Denatonium Benzoate) Solution Aerosol Qualitative Fit Test Protocol**

The Bitrex™ (Denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

##### **(a) Taste Threshold Screening.**

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4 inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

#### (b) Bitrex Solution Aerosol Fit Test Procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in 4. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex..

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.

(11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

## **5. Irritant Smoke (Stannic Chloride) Protocol**

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

### **(a) General Requirements and Precautions**

(1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Only stannic chloride smoke tubes shall be used for this protocol.

(3) No form of test enclosure or hood for the test subject shall be used.



(4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

(5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

### **(b) Sensitivity Screening Check**

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

(1) The test Shell shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test Shell shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(2) The test Shell shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.

(3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test Shell shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

### **(c) Irritant Smoke Fit Test Procedure**

(1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).

(2) The test subject shall be instructed to keep his/her eyes closed.

(3) The test Shell shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the test subject, using the low flow pump or the squeeze bulb. The test Shell shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The Shell shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.

(6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

(7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.

(8) If a response is produced during this second sensitivity check, then the fit test is passed.

### **C. Quantitative Fit Test (QNFT) Protocols**

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

#### **1. General**

(a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

#### **2. Generated Aerosol Quantitative Fit Testing Protocol**

(a) Apparatus.

(1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

(2) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the

test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.

(6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.

(7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.

(8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

(b) Procedural Requirements.

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

( A ) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

( B ) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

( C ) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

( D ) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

[A graphic goes here]

Where ff1, ff2, ff3, etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

### 3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Portacount Fit Test Requirements. (1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.

(2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.

(6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

(b) Portacount Test Instrument.

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, the test Shell shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.

(3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

4. Controlled negative pressure (CNP) quantitative fit testing protocol.

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The

level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) CNP Fit Test Requirements.

- (1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.
- (2) The CNP system defaults selected for test pressure shall be set at -15 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

**Note:**

CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.)

- (3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.
- (4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.
- (5) The test subject shall be trained to hold his or her breath for at least 20 seconds.
- (6) The test subject shall don the test respirator without any assistance from the individual who conducts the CNP fit test.
- (7) The QNFT protocol shall be followed according to section I. C. 1. of this appendix with an exception for the CNP test exercises.

**(b) CNP Test Exercises.**

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.

(4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.

(7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(8) Normal Breathing. The test subject shall remove and re-don the respirator within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

**(c) CNP Test Instrument.**



(1) The test instrument shall have an effective audio warning device when the test subject fails to hold his or her breath during the test. The test shall be terminated whenever the test subject failed to hold his or her breath. The test subject may be refitted and retested.

(2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

## **Part II. New Fit Test Protocols**

A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.

B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or

2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.

C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

## **APPENDIX B-1 TO §1910.134: USER SEAL CHECK PROCEDURES (MANDATORY)**

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

### **I. Facepiece Positive and/or Negative Pressure Checks**

*A. Positive pressure check.* Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

*B. Negative pressure check.* Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

### **II. Manufacturer's Recommended User Seal Check Procedures**

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the manufacturer's procedures are equally effective.

## **APPENDIX B-2 TO §1910.134: RESPIRATOR CLEANING PROCEDURES (MANDATORY)**

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B-2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

### **I. Procedures for Cleaning Respirators**

A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

B. Wash components in warm (43 °C [110 °F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

C. Rinse components thoroughly in clean, warm (43 °C [110 °F] maximum), preferably running water. Drain.

D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 °C (110 °F); or,

2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 °C (110 °F); or,

3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

E. Rinse components thoroughly in clean, warm (43 °C [110 °F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

F. Components should be hand-dried with a clean lint-free cloth or air-dried.

G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

H. Test the respirator to ensure that all components work properly.

## APPENDIX C TO §1910.134: OSHA RESPIRATOR MEDICAL EVALUATION QUESTIONNAIRE (MANDATORY)

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:

Can you read (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

**Part A. Section 1.** (Mandatory) The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date: \_\_\_\_\_

2. Your name: \_\_\_\_\_

3. Your age (to nearest year): \_\_\_\_\_

4. Sex (circle one): Male/Female

5. Your height: \_\_\_ft. \_\_\_in.

6. Your weight: \_\_\_ lbs.

7. Your job title: \_\_\_\_\_

8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code): \_\_\_\_\_

9. The best time to phone you at this number: \_\_\_\_\_

10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes/No

11. Check the type of respirator you will use (you can check more than one category):

a. \_\_\_ N, R, or P disposable respirator (filter-mask, non-cartridge type only).

b. \_\_\_ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).

12. Have you worn a respirator (circle one): Yes/No

If "yes," what type(s): \_\_\_\_\_

**Part A. Section 2.** (Mandatory) Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

1. Do you *currently* smoke tobacco, or have you smoked tobacco in the last month: Yes/No

2. Have you *ever had* any of the following conditions?

a. Seizures (fits): Yes/No

b. Diabetes (sugar disease): Yes/No

c. Allergic reactions that interfere with your breathing: Yes/No

d. Claustrophobia (fear of closed-in places): Yes/No

e. Trouble smelling odors: Yes/No

3. Have you *ever had* any of the following pulmonary or lung problems?

a. Asbestosis: Yes/No

b. Asthma: Yes/No

c. Chronic bronchitis: Yes/No

d. Emphysema: Yes/No

e. Pneumonia: Yes/No

f. Tuberculosis: Yes/No

g. Silicosis: Yes/No

h. Pneumothorax (collapsed lung): Yes/No

i. Lung cancer: Yes/No

j. Broken ribs: Yes/No

k. Any chest injuries or surgeries: Yes/No

l. Any other lung problem that you've been told about: Yes/No

4. Do you *currently* have any of the following symptoms of pulmonary or lung illness?
- a. Shortness of breath: Yes/No
  - b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes/No
  - c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes/No
  - d. Have to stop for breath when walking at your own pace on level ground: Yes/No
  - e. Shortness of breath when washing or dressing yourself: Yes/No
  - f. Shortness of breath that interferes with your job: Yes/No
  - g. Coughing that produces phlegm (thick sputum): Yes/No
  - h. Coughing that wakes you early in the morning: Yes/No
  - i. Coughing that occurs mostly when you are lying down: Yes/No
  - j. Coughing up blood in the last month: Yes/No
  - k. Wheezing: Yes/No
  - l. Wheezing that interferes with your job: Yes/No
  - m. Chest pain when you breathe deeply: Yes/No
  - n. Any other symptoms that you think may be related to lung problems: Yes/No
5. Have you *ever had* any of the following cardiovascular or heart problems?
- a. Heart attack: Yes/No
  - b. Stroke: Yes/No
  - c. Angina: Yes/No
  - d. Heart failure: Yes/No
  - e. Swelling in your legs or feet (not caused by walking): Yes/No
  - f. Heart arrhythmia (heart beating irregularly): Yes/No
  - g. High blood pressure: Yes/No

- h. Any other heart problem that you've been told about: Yes/No
6. Have you *ever had* any of the following cardiovascular or heart symptoms?
- a. Frequent pain or tightness in your chest: Yes/No
  - b. Pain or tightness in your chest during physical activity: Yes/No
  - c. Pain or tightness in your chest that interferes with your job: Yes/No
  - d. In the past two years, have you noticed your heart skipping or missing a beat: Yes/No
  - e. Heartburn or indigestion that is not related to eating: Yes/No
  - f. Any other symptoms that you think may be related to heart or circulation problems: Yes/No
7. Do you *currently* take medication for any of the following problems?
- a. Breathing or lung problems: Yes/No
  - b. Heart trouble: Yes/No
  - c. Blood pressure: Yes/No
  - d. Seizures (fits): Yes/No
8. If you've used a respirator, have you *ever had* any of the following problems? (If you've never used a respirator, check the following space and go to question 9:)
- a. Eye irritation: Yes/No
  - b. Skin allergies or rashes: Yes/No
  - c. Anxiety: Yes/No
  - d. General weakness or fatigue: Yes/No
  - e. Any other problem that interferes with your use of a respirator: Yes/No
9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes/No

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you *ever lost* vision in either eye (temporarily or permanently): Yes/No

11. Do you *currently* have any of the following vision problems?

- a. Wear contact lenses: Yes/No
- b. Wear glasses: Yes/No
- c. Color blind: Yes/No
- d. Any other eye or vision problem: Yes/No

12. Have you *ever had* an injury to your ears, including a broken ear drum: Yes/No

13. Do you *currently* have any of the following hearing problems?

- a. Difficulty hearing: Yes/No
- b. Wear a hearing aid: Yes/No
- c. Any other hearing or ear problem: Yes/No

14. Have you *ever had* a back injury: Yes/No

15. Do you *currently* have any of the following musculoskeletal problems?

- a. Weakness in any of your arms, hands, legs, or feet: Yes/No
- b. Back pain: Yes/No
- c. Difficulty fully moving your arms and legs: Yes/No
- d. Pain or stiffness when you lean forward or backward at the waist: Yes/No
- e. Difficulty fully moving your head up or down: Yes/No
- f. Difficulty fully moving your head side to side: Yes/No
- g. Difficulty bending at your knees: Yes/No
- h. Difficulty squatting to the ground: Yes/No
- i. Climbing a flight of stairs or a ladder carrying more than 25 lbs: Yes/No



j. Any other muscle or skeletal problem that interferes with using a respirator: Yes/No

**Part B** Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes/No

If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes/No

2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes/No

If "yes," name the chemicals if you know them: \_\_\_\_\_

3. Have you ever worked with any of the materials, or under any of the conditions, listed below:

a. Asbestos: Yes/No

b. Silica (e.g., in sandblasting): Yes/No

c. Tungsten/cobalt (e.g., grinding or welding this material): Yes/No

d. Beryllium: Yes/No

e. Aluminum: Yes/No

f. Coal (for example, mining): Yes/No

g. Iron: Yes/No

h. Tin: Yes/No

i. Dusty environments: Yes/No

j. Any other hazardous exposures: Yes/No

If "yes," describe these exposures: \_\_\_\_\_

\_\_\_\_\_

4. List any second jobs or side businesses you have: \_\_\_\_\_

5. List your previous occupations: \_\_\_\_\_

6. List your current and previous hobbies: \_\_\_\_\_

7. Have you been in the military services? Yes/No

If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes/No

8. Have you ever worked on a HAZMAT team? Yes/No

9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes/No

If "yes," name the medications if you know them: \_\_\_\_\_

10. Will you be using any of the following items with your respirator(s)?

a. HEPA Filters: Yes/No

b. Canisters (for example, gas masks): Yes/No

c. Cartridges: Yes/No

11. How often are you expected to use the respirator(s) (circle "yes" or "no" for all answers that apply to you)?:

a. Escape only (no rescue): Yes/No

b. Emergency rescue only: Yes/No

c. Less than 5 hours *per week*: Yes/No

d. Less than 2 hours *per day*: Yes/No

e. 2 to 4 hours *per day*: Yes/No

f. Over 4 hours *per day*: Yes/No

12. During the period you are using the respirator(s), is your work effort:

a. *Light* (less than 200 kcal per hour): Yes/No

If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.

Examples of a light work effort are *sitting* while writing, typing, drafting, or performing light assembly work; or *standing* while operating a drill press (1-3 lbs.) or controlling machines.

b. *Moderate* (200 to 350 kcal per hour): Yes/No

If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.

Examples of moderate work effort are *sitting* while nailing or filing; *driving* a truck or bus in urban traffic; *standing* while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; *walking* on a level surface about 2 mph or down a 5-degree grade about 3 mph; or *pushing* a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

c. *Heavy* (above 350 kcal per hour): Yes/No

If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.

Examples of heavy work are *lifting* a heavy load (about 50 lbs.) from the floor to your waist or shoulder; *working* on a loading dock; *shoveling*; *standing* while bricklaying or chipping castings; *walking* up an 8-degree grade about 2 mph; *climbing* stairs with a heavy load (about 50 lbs.).

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No If "yes," describe this protective clothing and/or equipment: \_\_\_\_\_

\_\_\_\_\_

14. Will you be working under hot conditions (temperature exceeding 77 °F): Yes/No

15. Will you be working under humid conditions: Yes/No

16. Describe the work you'll be doing while you're using your respirator(s): \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases): \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s):

Name of the first toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift \_\_\_\_\_

Name of the second toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift: \_\_\_\_\_

Name of the third toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift: \_\_\_\_\_

The name of any other toxic substances that you'll be exposed to while using your respirator:

\_\_\_\_\_  
\_\_\_\_\_

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security): \_\_\_\_\_

\_\_\_\_\_

## **APPENDIX D TO §1910.134 (MANDATORY) INFORMATION FOR EMPLOYEES USING RESPIRATORS WHEN NOT REQUIRED UNDER THE STANDARD**

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker.

Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

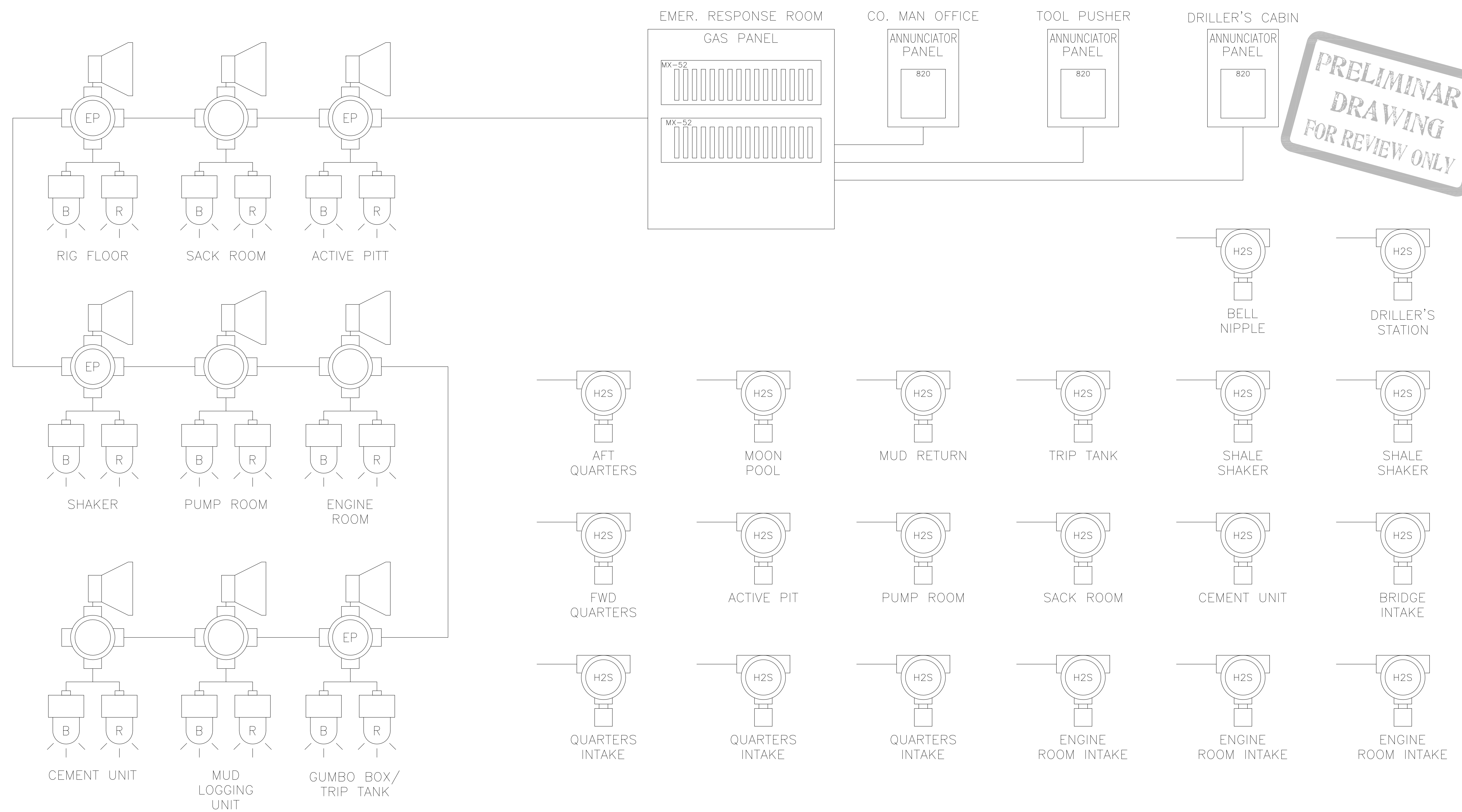
You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.
2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.
3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.
4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[63 FR 1270, Jan. 8, 1998; 63 FR 20098, 20099, Apr. 23, 1998]

## SECTION E DRAWINGS

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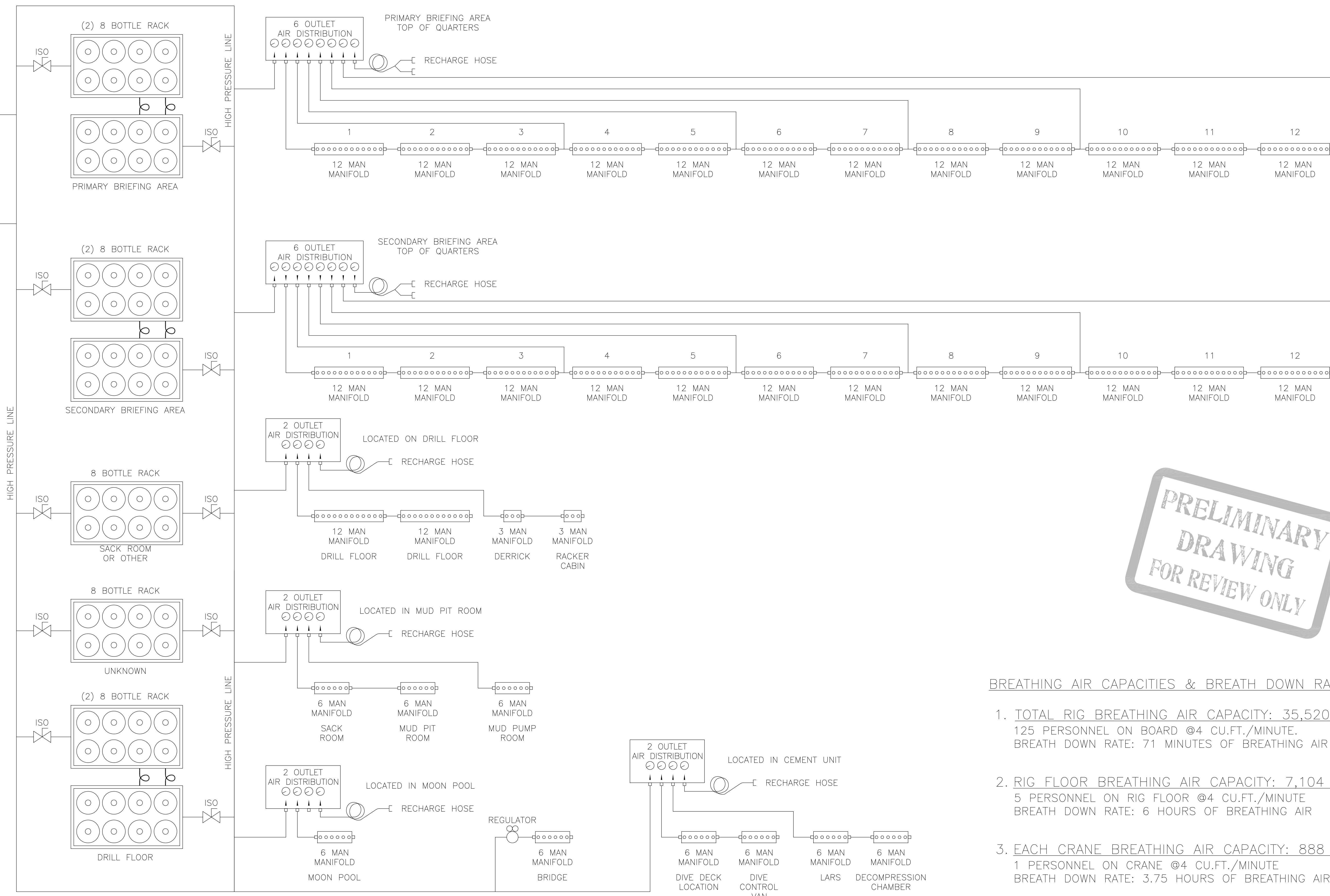
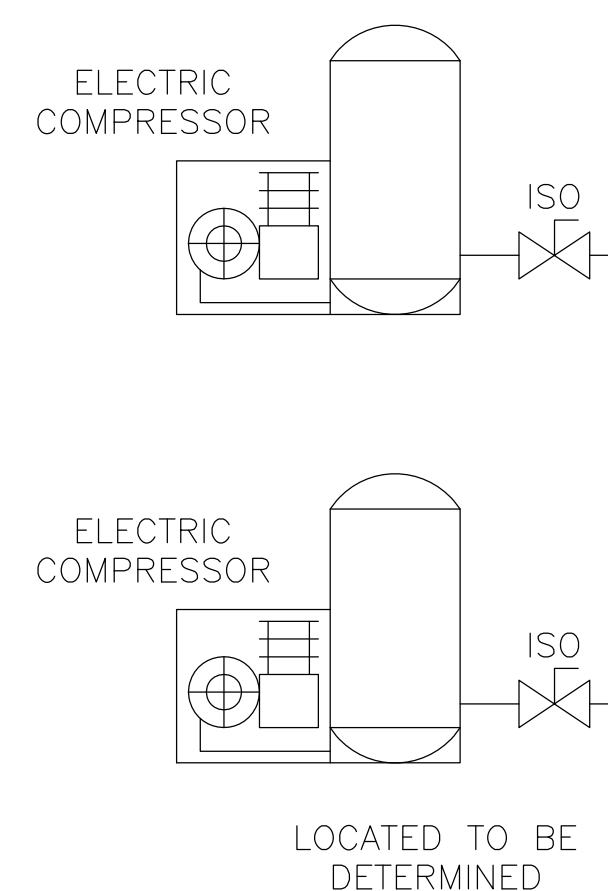
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JOB No.: \_\_\_\_\_ CHECKED BY: \_\_\_\_\_  
PLOT SCALE: 1=1 APPROVED BY: \_\_\_\_\_

*M/V FRONTIER DISCOVEROR*  
CHUCKCHI SEA  
H2S SAFETY PLAN  
GAS DETECTION ONE LINE  
SHEET REFERENCE NUMBER PRELIM 001 REV. A



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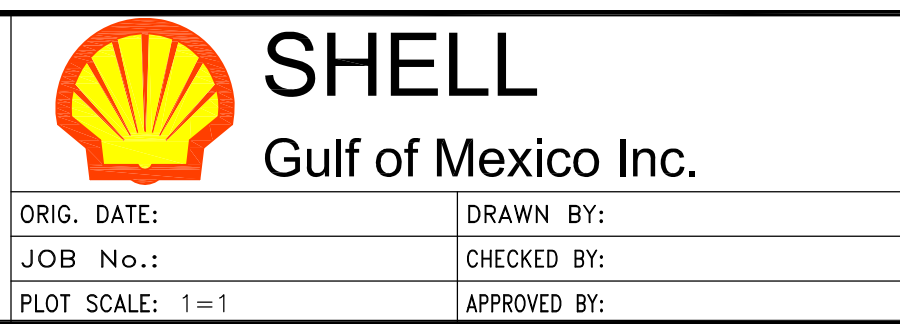
BREATHING AIR CAPACITIES & BREATH DOWN RATES

1. TOTAL RIG BREATHING AIR CAPACITY: 35,520 CU.FT.  
125 PERSONNEL ON BOARD @4 CU.FT./MINUTE.  
BREATH DOWN RATE: 71 MINUTES OF BREATHING AIR
2. RIG FLOOR BREATHING AIR CAPACITY: 7,104 CU.FT.  
5 PERSONNEL ON RIG FLOOR @4 CU.FT./MINUTE  
BREATH DOWN RATE: 6 HOURS OF BREATHING AIR
3. EACH CRANE BREATHING AIR CAPACITY: 888 CU.FT.  
1 PERSONNEL ON CRANE @4 CU.FT./MINUTE  
BREATH DOWN RATE: 3.75 HOURS OF BREATHING AIR

NOTES:  
1. ALL TUBING IS 3/8" STAINLESS STEEL TUBING

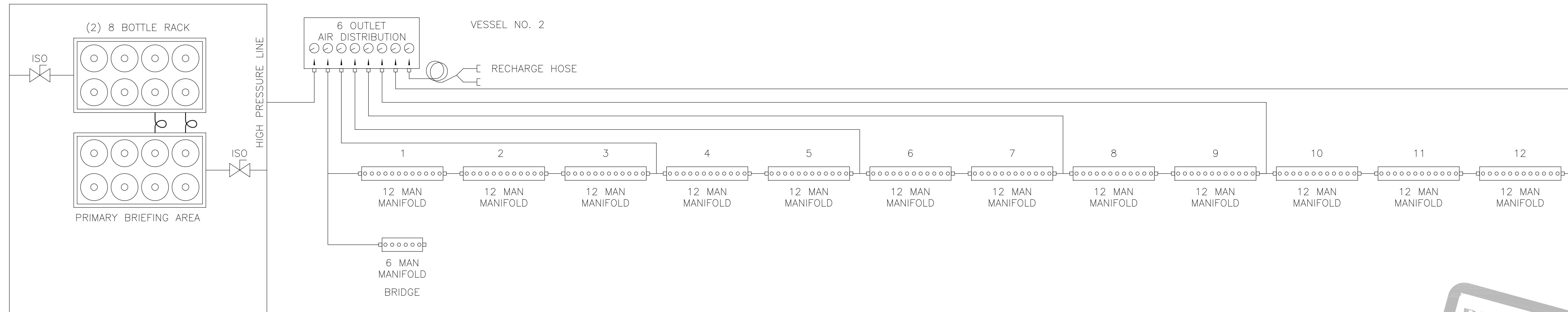
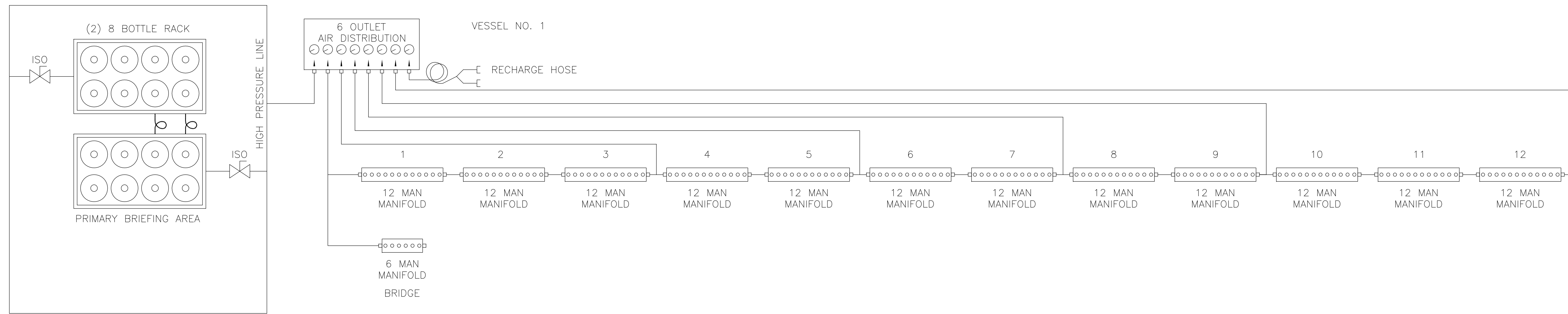
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M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
BREATHING AIR ONE LINE  
SHEET 1 OF 2  
REFERENCE NUMBER  
PRELIM 002  
REV. A



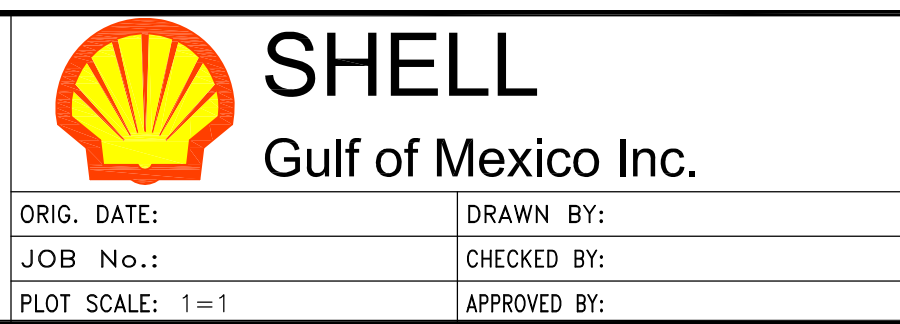


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NOTES:  
1. ALL TUBING IS 3/8" STAINLESS STEEL TUBING

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M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
BREATHING AIR ONE LINE  
SHEET 2 OF 2  
REFERENCE NUMBER  
PRELIM 003  
REV. A

# MAIN DECK

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	1	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	12	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	-	10 MINUTE SCBA CADET
	38	30 MINUTE SCBA AIR HAWK
	2	H2S GAS DETECTOR
	5	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

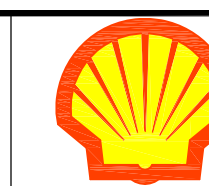


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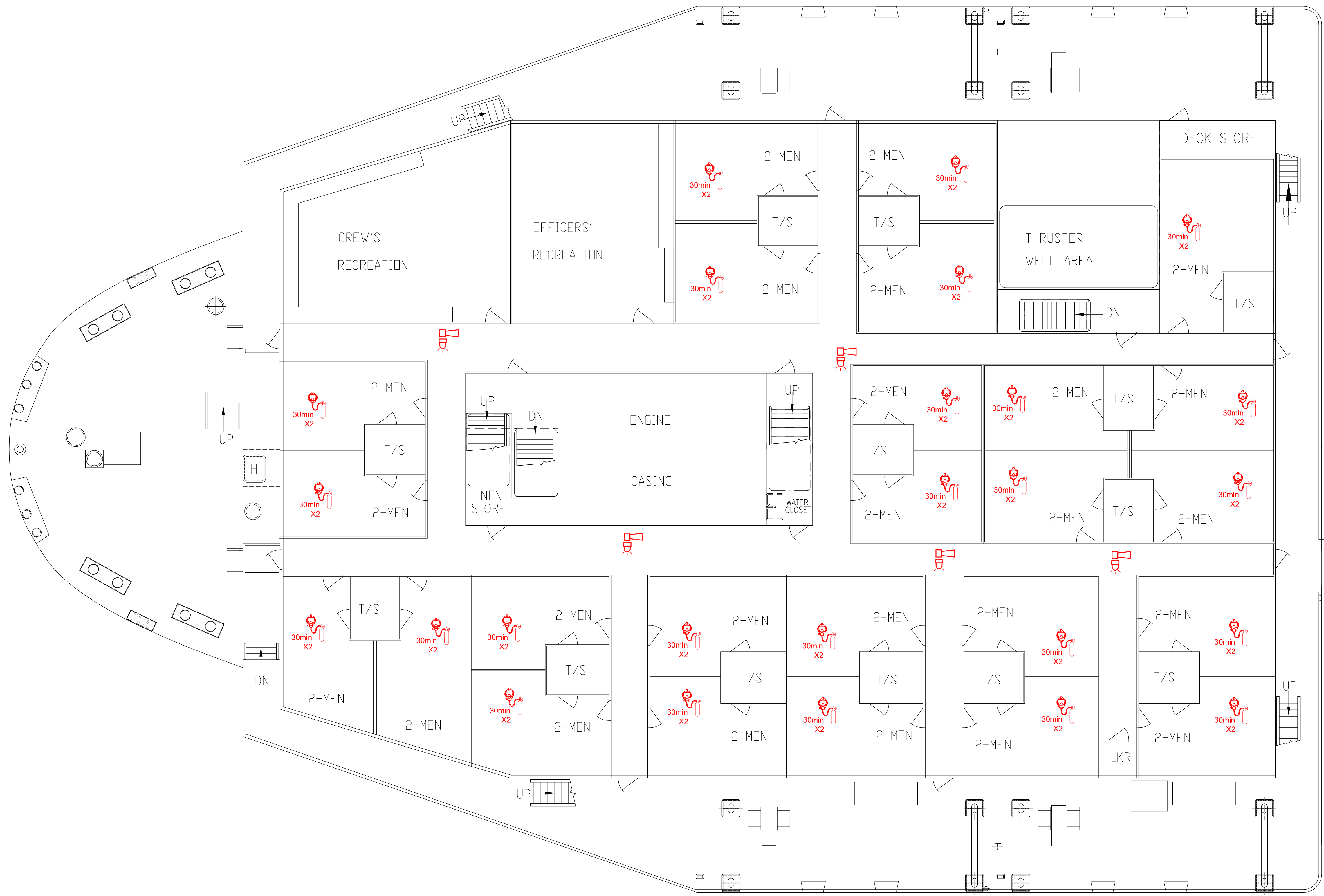
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JOB No.:	CHECKED BY:
PLOT SCALE: 1=1	APPROVED BY:

M/V FRONTIER DISCOVEROR		REV.
CHUCKCHI SEA		A
H2S SAFETY PLAN		
QUARTERS MAIN DECK EQUIPMENT LAYOUT		
SHEET	REFERENCE NUMBER	
	PRELIM 004	

# POOP DECK

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	-	10 MINUTE SCBA CADET
	50	30 MINUTE SCBA AIR HAWK
	-	H2S GAS DETECTOR
	5	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL



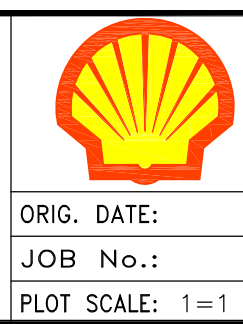
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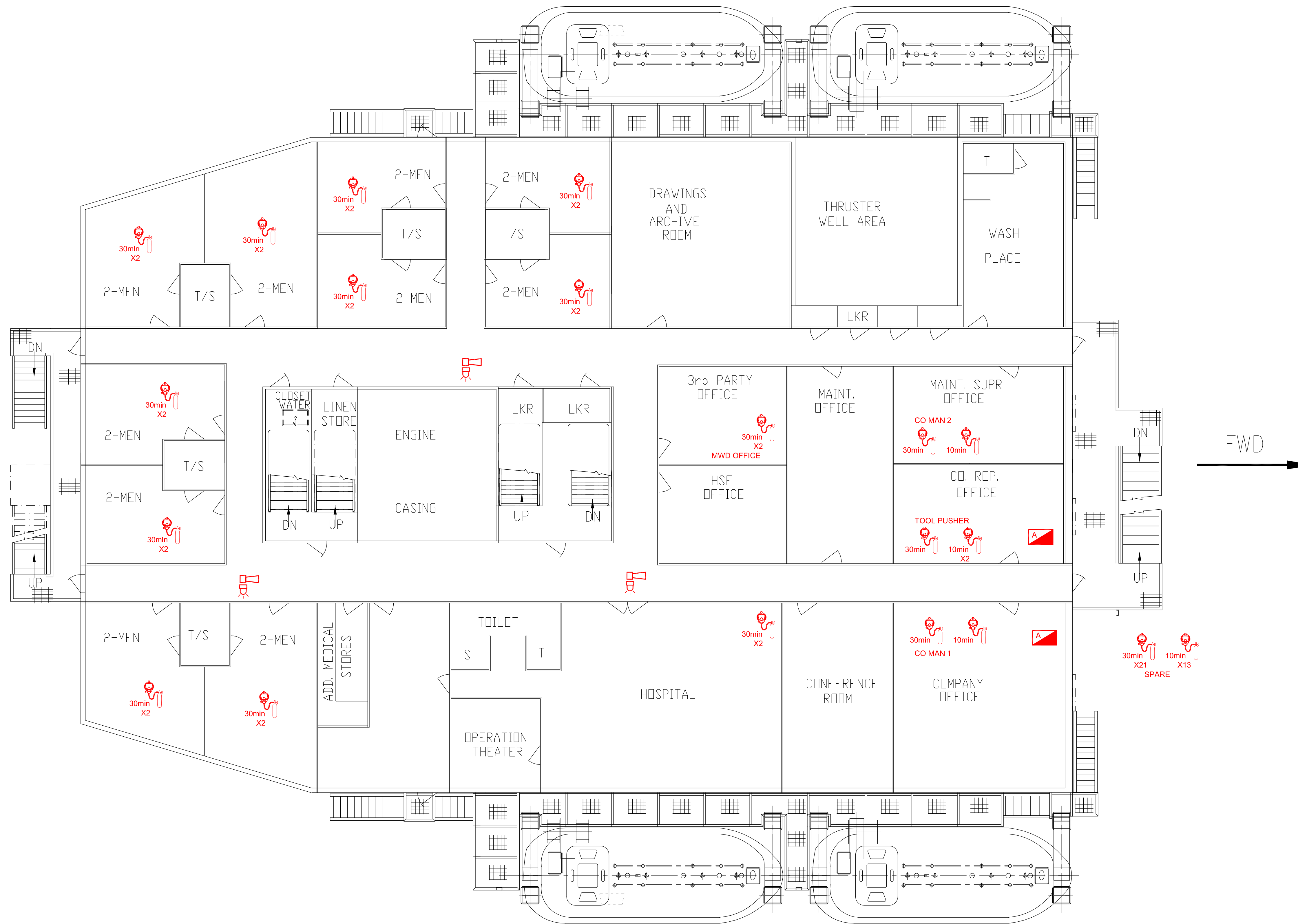
M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
QUARTERS POOP DECK EQUIPMENT LAYOUT  
SHEET \_\_\_\_\_ REFERENCE NUMBER PRELIM 005 REV. A



# BOAT DECK

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	17	10 MINUTE SCBA CADET
	48	30 MINUTE SCBA AIR HAWK
	-	H2S GAS DETECTOR
	3	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	2	GAS DETECTION ANNUNCIATOR PANEL



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CHUCKCHI SEA  
H2S SAFETY PLAN  
QUARTERS BOAT DECK EQUIPMENT LAYOUT

SHEET \_\_\_\_\_ REFERENCE NUMBER PRELIM 006 REV. A



# NAV. BRIDGE DECK

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	5	10 MINUTE SCBA CADET
	26	30 MINUTE SCBA AIR HAWK
	-	H2S GAS DETECTOR
	2	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	1	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

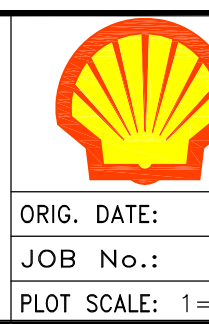


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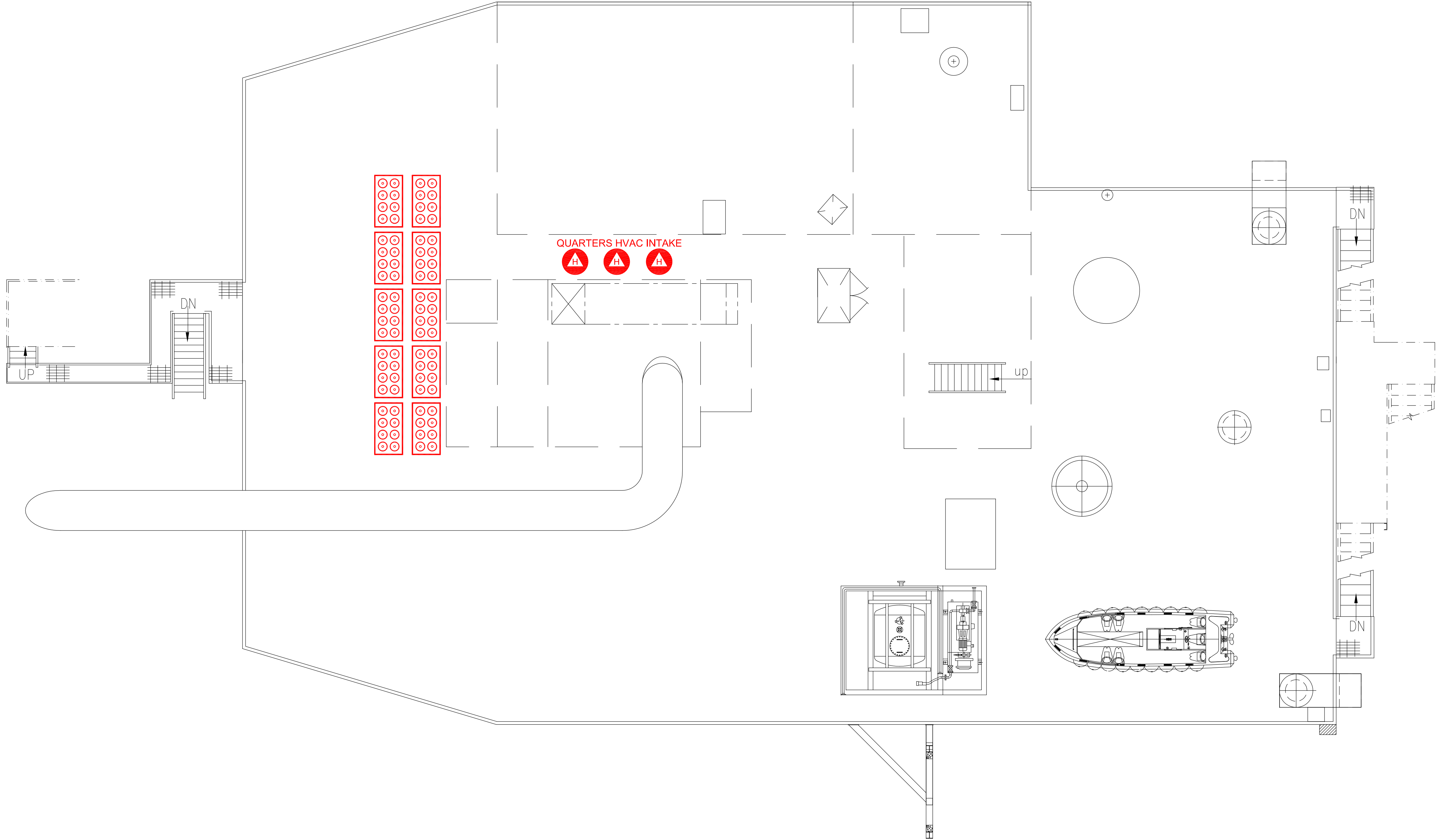
M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
QUARTERS NAV. BRIDGE DECK  
EQUIPMENT LAYOUT  
REFERENCE NUMBER  
PRELIM 008  
SHEET                      REV. A



# HOUSE TOP

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	10	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	-	10 MINUTE SCBA CADET
	-	30 MINUTE SCBA AIR HAWK
	3	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
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CHUCKCHI SEA  
H2S SAFETY PLAN  
HOUSE TOP EQUIPMENT LAYOUT

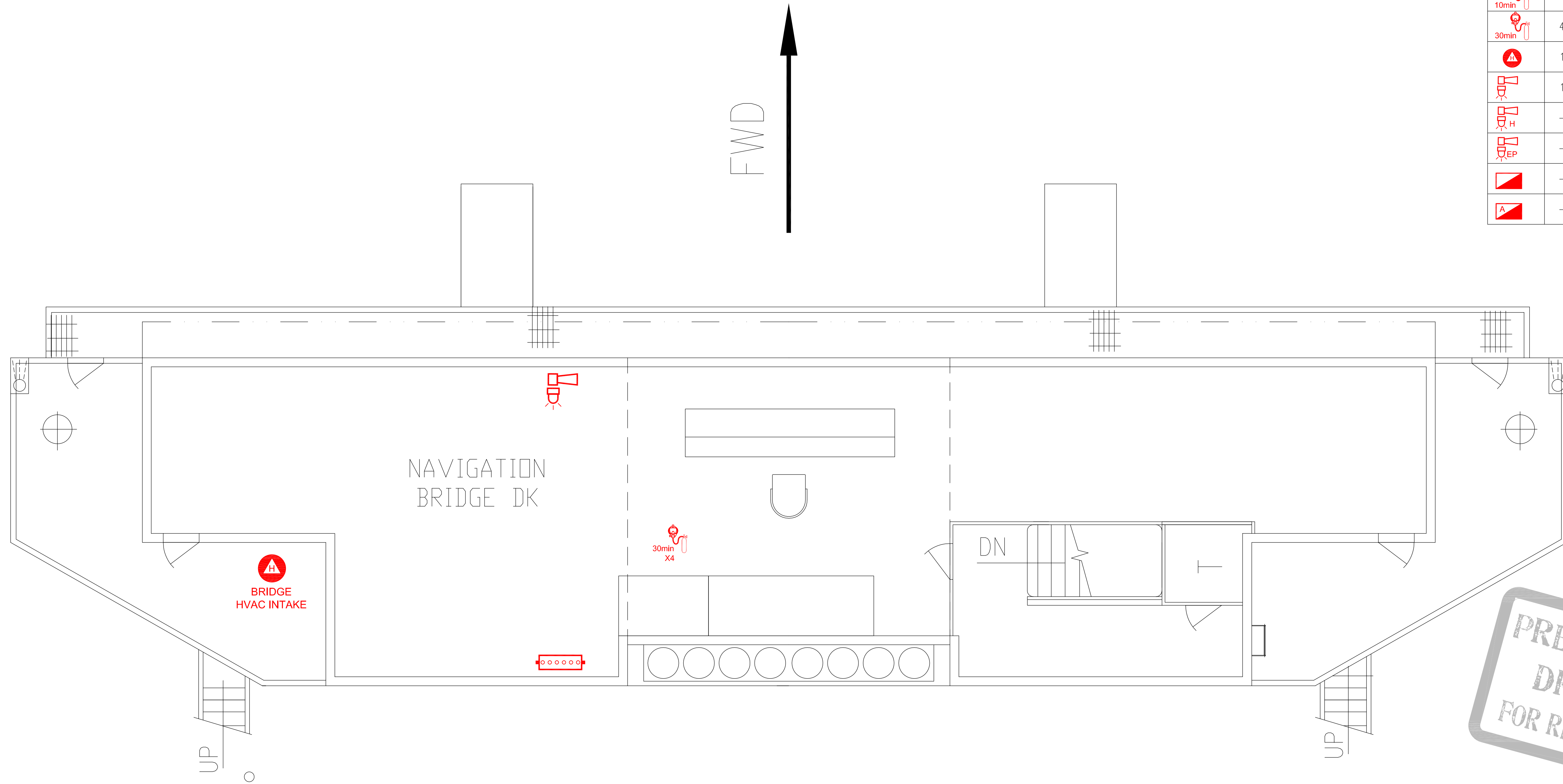
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PRELIM 009

REV.  
A

# FORWARD BRIDGE

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	1	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	-	10 MINUTE SCBA CADET
	4	30 MINUTE SCBA AIR HAWK
	1	H2S GAS DETECTOR
	1	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL



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PLOT SCALE: 1=1 APPROVED BY: \_\_\_\_\_

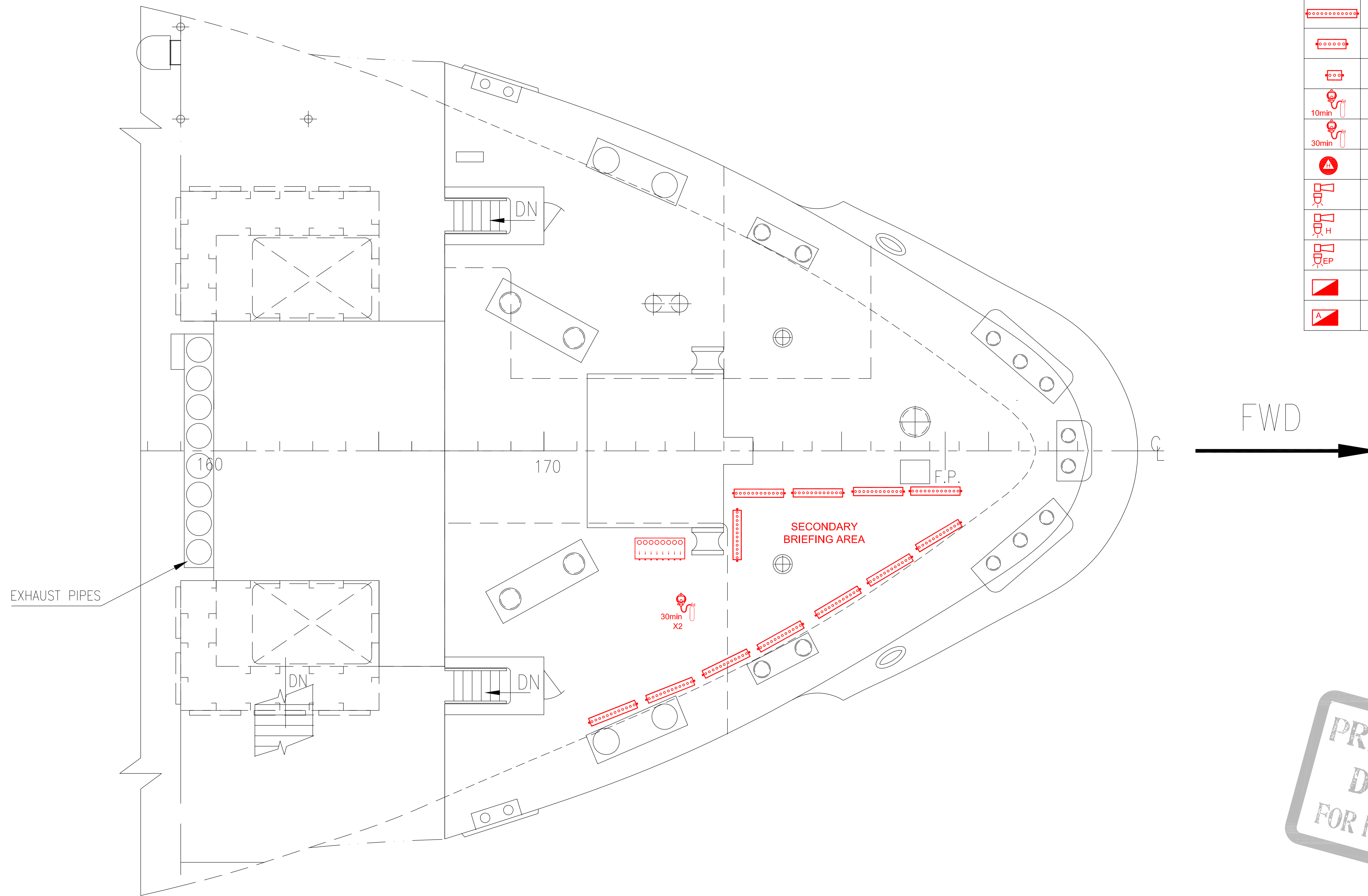
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CHUCKCHI SEA  
H2S SAFETY PLAN  
FORWARD BRIDGE EQUIPMENT LAYOUT  
SHEET REFERENCE NUMBER PRELIM 010 REV. A



# MAIN DECK BOW

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	1	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	12	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	-	10 MINUTE SCBA CADET
	2	30 MINUTE SCBA AIR HAWK
	-	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL



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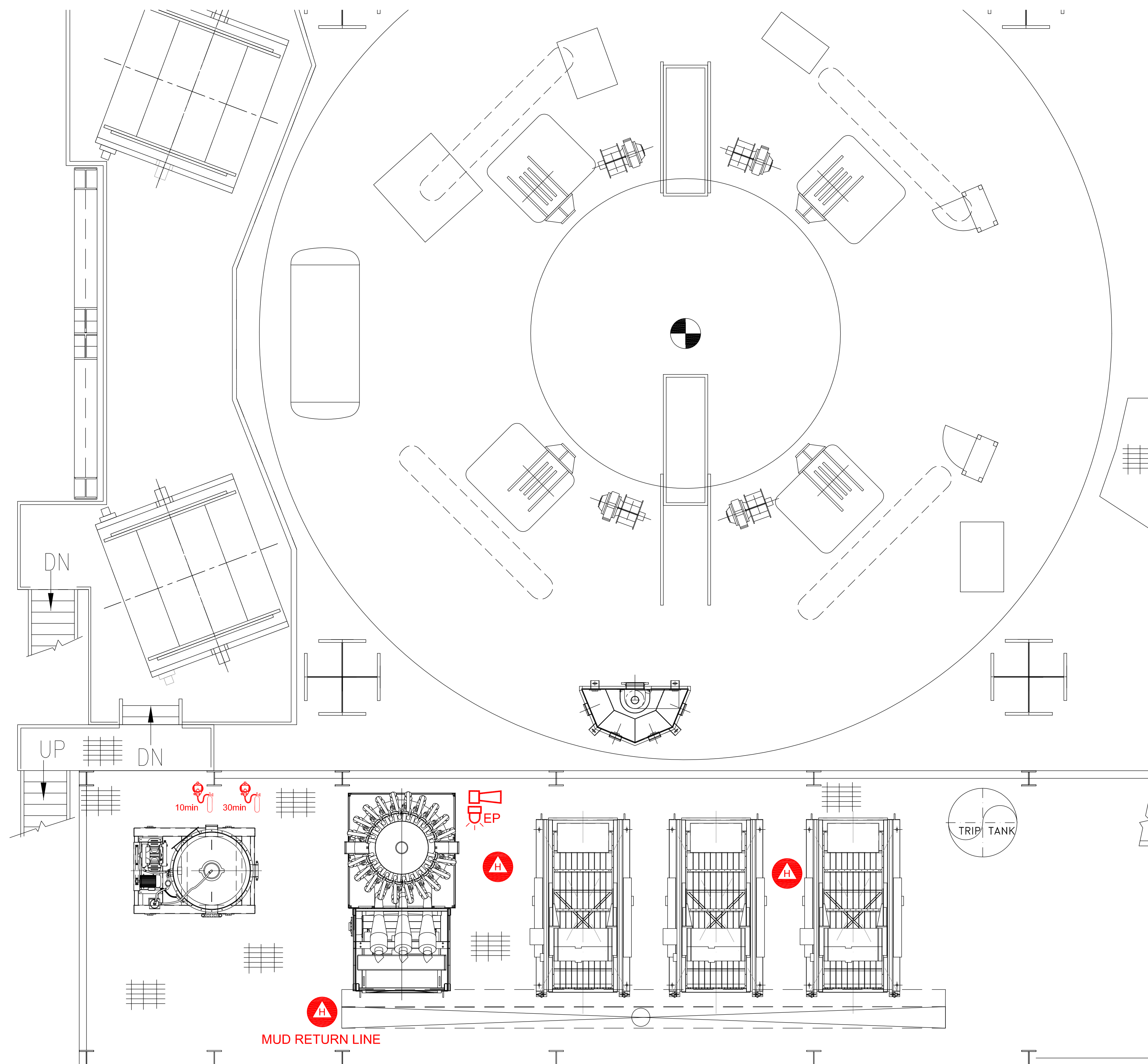
**SHELL**  
Gulf of Mexico Inc.  
ORIG. DATE: \_\_\_\_\_ DRAWN BY: \_\_\_\_\_  
JOB No.: \_\_\_\_\_ CHECKED BY: \_\_\_\_\_  
PLOT SCALE: 1=1 APPROVED BY: \_\_\_\_\_

M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
MAIN DECK BOW EQUIPMENT LAYOUT  
SHEET REFERENCE NUMBER PRELIM 011 REV. A





# SHAKERS



## SYMBOL KEY LEGEND

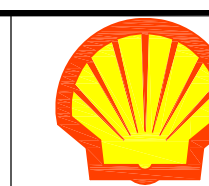
SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	1	10 MINUTE SCBA CADET
	1	30 MINUTE SCBA AIR HAWK
	3	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	1	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

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Gulf of Mexico Inc.

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PLOT SCALE: 1=1	APPROVED BY:

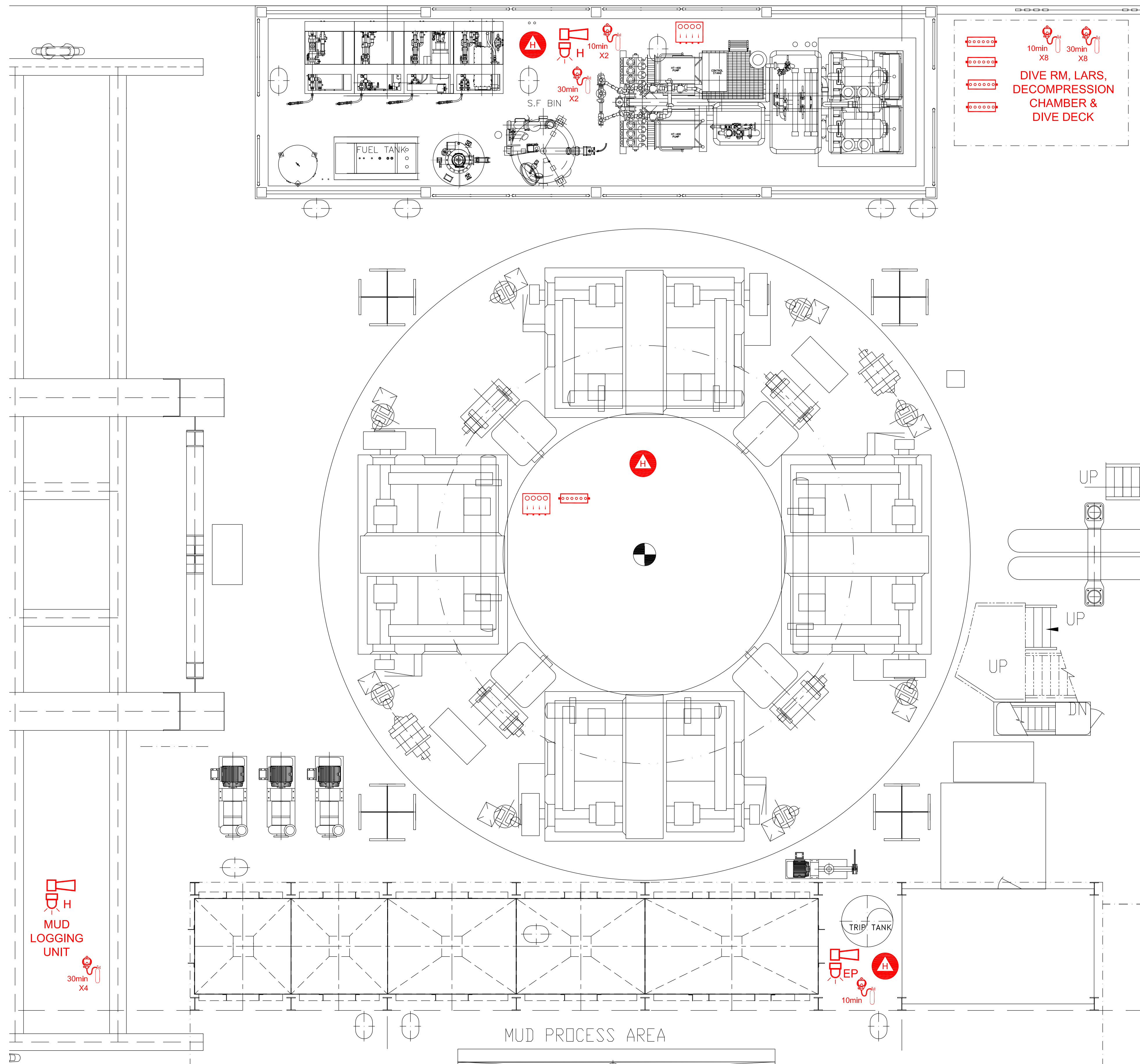
SHEET	REFERENCE NUMBER PRELIM 013	REV. A
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M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
SHAKERS EQUIPMENT LAYOUT

**CEMENT UNIT**

**MOON POOL**

**MUD PROCESS AREA**



**SYMBOL KEY LEGEND**

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	2	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	5	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	11	10 MINUTE SCBA CADET
	14	30 MINUTE SCBA AIR HAWK
	3	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	2	OUTDOOR ALARM STATION
	1	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

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Gulf of Mexico Inc.

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JOB No.:          CHECKED BY:  
PLOT SCALE: 1=1      APPROVED BY:

M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
CEMENT UNIT & MOON POOL  
EQUIPMENT LAYOUT

REFERENCE NUMBER  
PRELIM 014

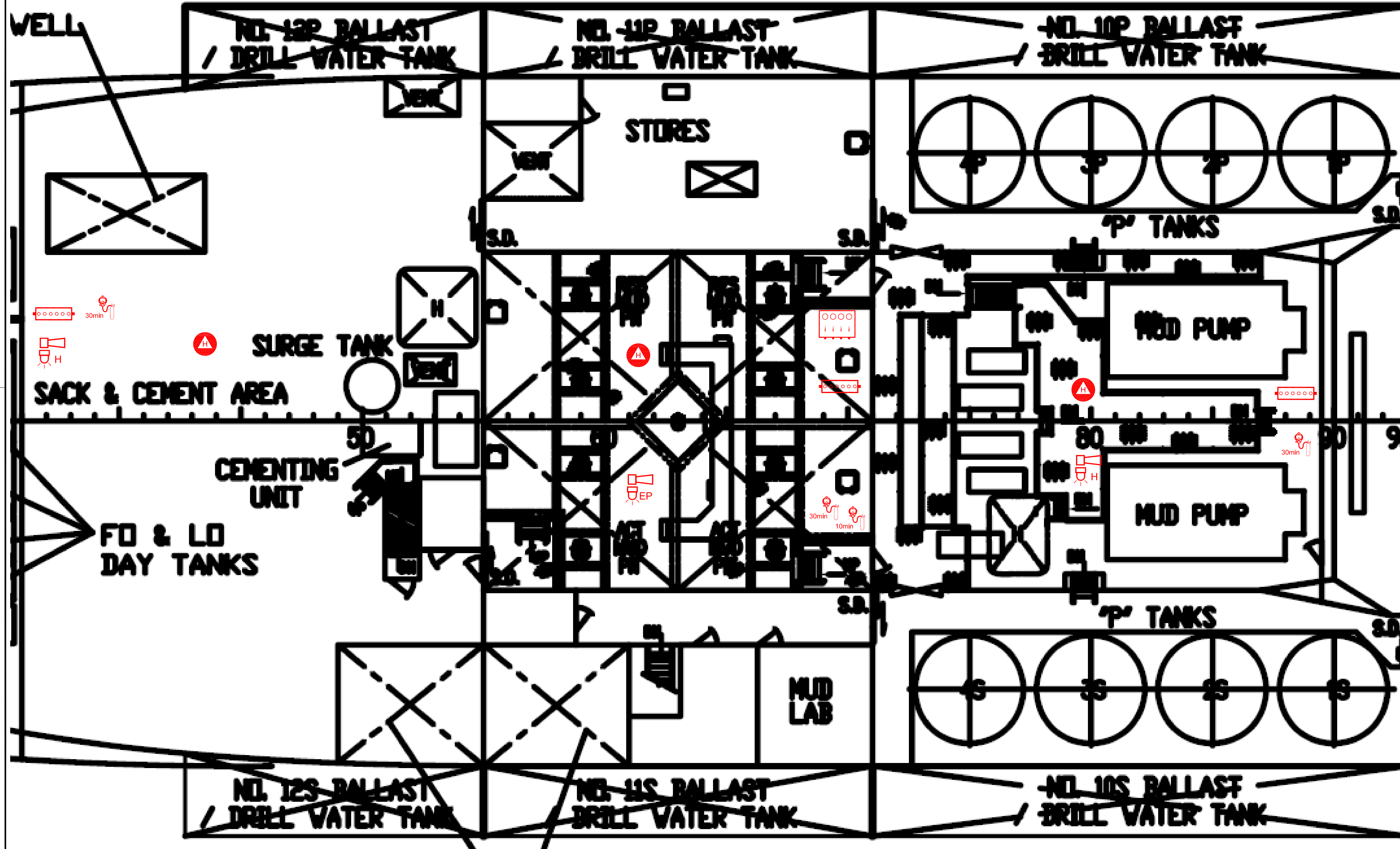
SHEET      REV. A



# SACK ROOM, MUD PITS & MUD PUMPS

## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	1	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	3	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	1	10 MINUTE SCBA CADET
	3	30 MINUTE SCBA AIR HAWK
	3	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	2	OUTDOOR ALARM STATION
	1	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

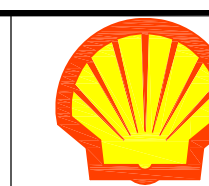


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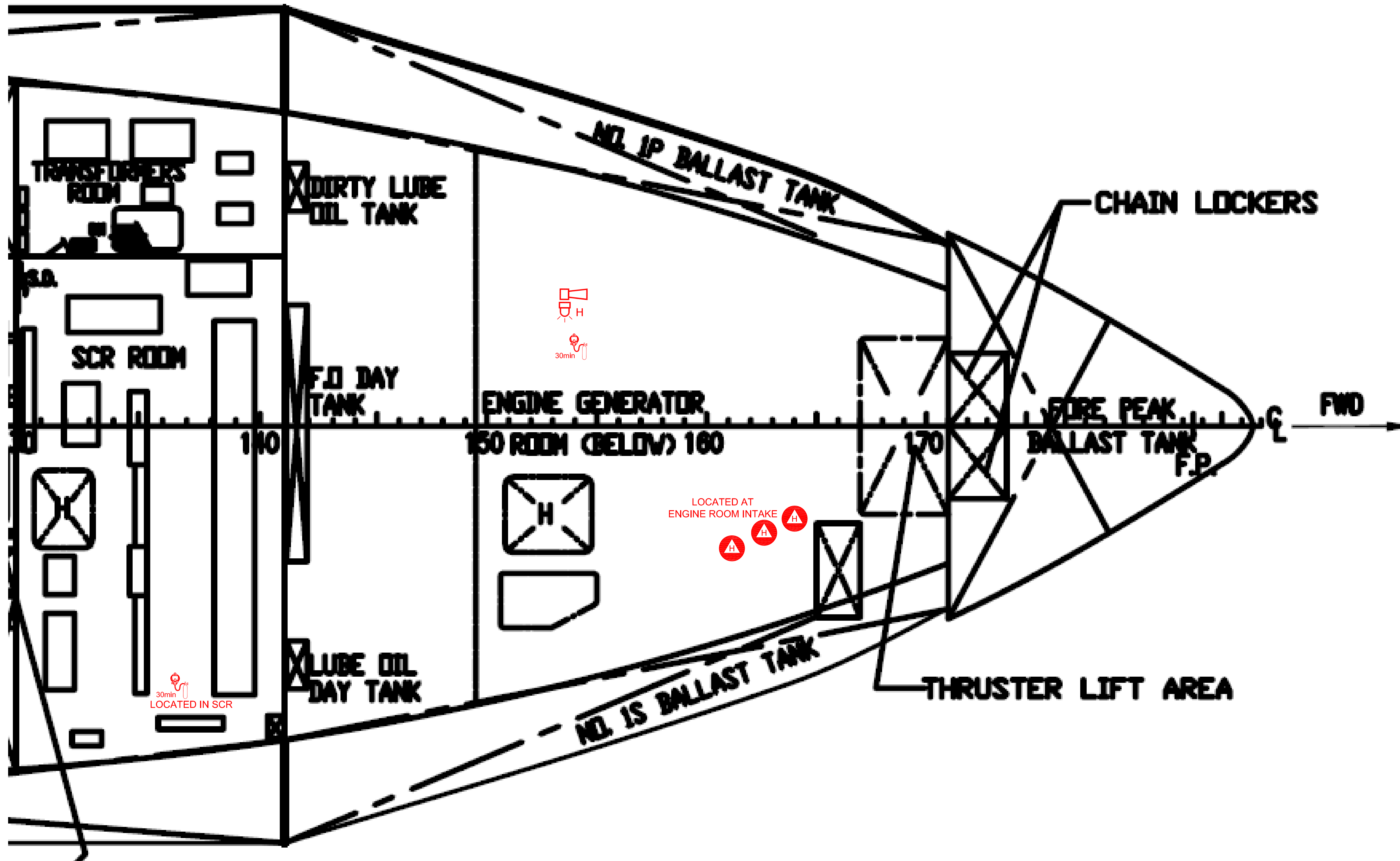
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Gulf of Mexico Inc.

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JOB No.:                              CHECKED BY:  
PLOT SCALE: 1=1                      APPROVED BY:

M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
SACK RM, PUMP RM & MUD PIT  
EQUIPMENT LAYOUT  
REFERENCE NUMBER  
PRELIM 015

SHEET                      REV. A

# SCR & ENGINE ROOM



## SYMBOL KEY LEGEND

SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	-	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	-	10 MINUTE SCBA CADET
	2	30 MINUTE SCBA AIR HAWK
	3	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	1	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

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Gulf of Mexico Inc.  
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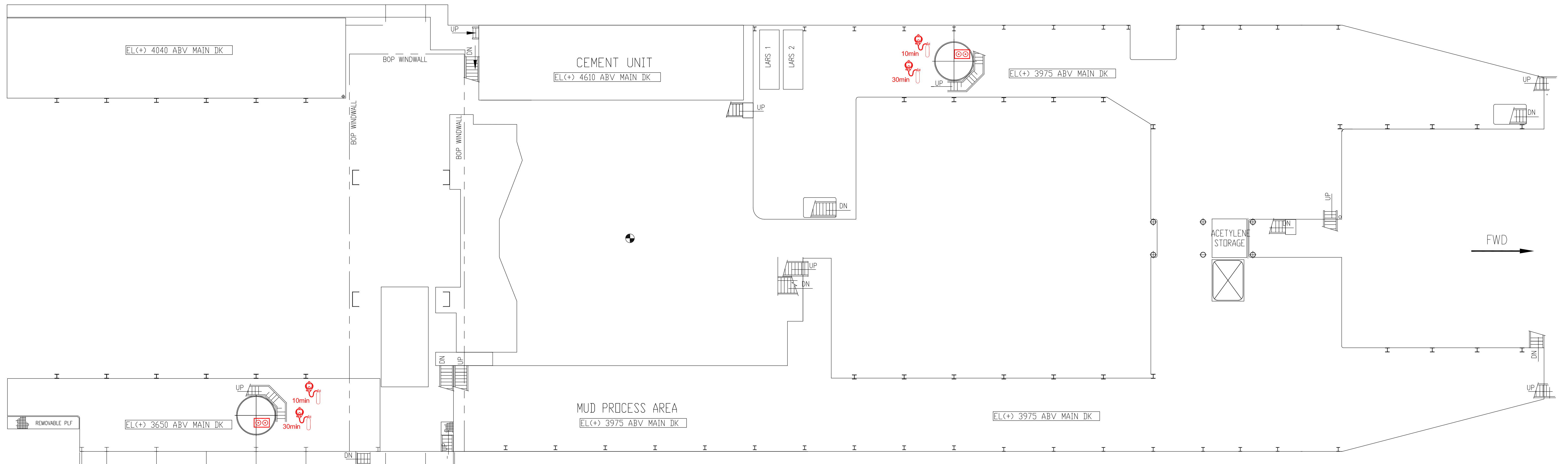
M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
SCR & ENGINE ROOM EQUIPMENT LAYOUT  
SHEET                      REFERENCE NUMBER                      REV.  
PRELIM 016                      A

# CRANES

## SYMBOL KEY LEGEND

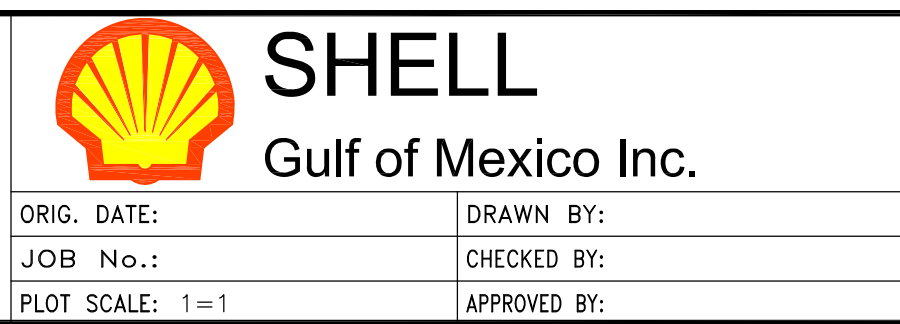
SYMBOL	QTY	NAME
	-	8 BOTTLE RACK
	2	2 BOTTLE RACK
	-	6 OUTLET AIR DIST. PANEL
	-	2 OUTLET AIR DIST. PANEL
	-	ELECTRIC COMPRESSOR
	-	12 MAN MANIFOLD IN A BOX
	-	6 MAN MANIFOLD IN A BOX
	-	3 MAN MANIFOLD IN A BOX
	2	10 MINUTE SCBA CADET
	2	30 MINUTE SCBA AIR HAWK
	-	H2S GAS DETECTOR
	-	INDOOR ALARM STATION
	-	OUTDOOR ALARM STATION
	-	OUTDOOR ALARM STATION EP
	-	GAS DETECTION PANEL
	-	GAS DETECTION ANNUNCIATOR PANEL

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M/V FRONTIER DISCOVEROR  
CHUCKCHI SEA  
H2S SAFETY PLAN  
CRANES EQUIPMENT LAYOUT

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 PLOT SCALE: 1=1 APPROVED BY: \_\_\_\_\_

SHEET \_\_\_\_\_ REFERENCE NUMBER PRELIM 017 REV. A

