Presentation to N.M. Oil Conservation Division in Reference to N.M. State Proposed Rule 19.15.2.52 for Hydrogen Sulfide Gas

SAFETY CONSULTING & TRAINING
COMPLIANCE EDUCATION SPECIALISTS
DOT MSHA OSHA

Designed and Presented by:

John W. Prather, SHS/CSHS/ES
SAFETY CONSULTING & TRAINING, LLC
823 Sunrise Circle
P.O. Box 5212
Hobbs, NM 88241-5212
(505)397-4215

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Presentation from John W. Prather, SHS/CSHS/ES to Oil Conservation Commission, Santa Fe, NM, September 20, 2002

I currently am co-owner of Safety Consulting & Training, LLC, in Hobbs, N.M., where for the last 8 years, I have conducted industrial safety and compliance training for a number of oil and gas service companies, production companies and refineries, using compliance standards of the Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA) as well as Mine Safety and Health Administration (MSHA).

I have 37+ years of experience in the mining, petrochemical refining, and oil & gas industries. My experience as a trainer dates back to my military service with the U.S. Navy/U.S. Marine Corps. I have certifications from MSHA as a Safety, Health and First Aid Instructor and proudly carry the notorious mining industry "Blue Card". I have completed the Department of Labor, OSHA Training Institutes requirement and have been awarded a certificate as a" Safety & Health Specialist" (SHS), a certificate as a "Construction Safety & Health Specialist" (CSHS) and most recently have received a certificate as an "Environmental Specialist" (ES).

In addition, I have completed the requirements of the American Society of Safety Engineers (ASSE) Safety Management Program and have been awarded a "Certificate in Safety Management", and most recently have completed the NCCER requirements as a "Master Trainer".

I am certified as an H_2S Instructor in accordance with ANSI Z390.1-1995 (R-2000), as well as a Medic, National Safety Council and American Red Cross First Aid/ CPR Instructor. With the experience and training combined, I have met the requirements of OSHA 29CFR 1910.120 , Appendix E, as a Training Director/ Instructor.

In perusal of the most recent draft copies of Rule 19.15.2.51 & 19.15.2.52 , we have found 4 areas that have caused us a great deal of concern. The first being in 19.15.2.51, paragraph C– Definitions, Potentially Hazardous Volume. The levels of H_2S referred to as Hazardous Volumes being 100 ppm and 500 ppm, we feel that these levels are extremely high, considering recent documentation on physical damage to the human body as well as long term and lasting residual effects that take place at much lower levels. I refer you to the first enclosed document, , Hydrogen Sulfide, Immediately Dangerous to Life and Health (IDLH) documentation. This document, coming from **NIOSH** and last updated August 16, l996, gives a level of 100 ppm as being Immediately Dangerous to Life & Health (IDLH) with an American Congress of Industrial Hygienist, Threshold Limit Value (TLV) as being 10 ppm.

Based on this document, the NIOSH recommended exposure limit of 10 ppm has become a point in which many agencies require that some sort of corrective action be taken. I refer you to the second enclosed document, a copy of the ***Federal Registry of the U. S. Congress, Volume 62, # 17, Monday January 27, l997, Rules and Regulations, Department of the Interior, Minerals Management Service, 30 CFR Part 250. Hydrogen Sulfide Requirements For Operations in the Outer Continental Shelf.*** This document, in many places, refers to contingency plans, monitoring equipment, etc., and throughout the document, never allows levels to exceed 20 ppm without some sort of corrective action, (i.e. ***250.67 Hydrogen Sulfide, paragraph F, page 3796,***

Item 5, Actions that you will take when the concentrations of H2S 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." The same paragraph F part 10, ***"The agencies and facilities you will notify in case of a release of H_2S, [that constitute 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_2S. "***

30 CFR Ch. II, Appendix B, Paragraph 10– Responsibilities and Duties, ii, ***The duties or responsibilities and operating procedures to be initiated when the concentration of H_2S in the atmosphere reaches the following ; (a) 10 ppm level (b) 20 ppm level, and (c) 50 ppm level.***

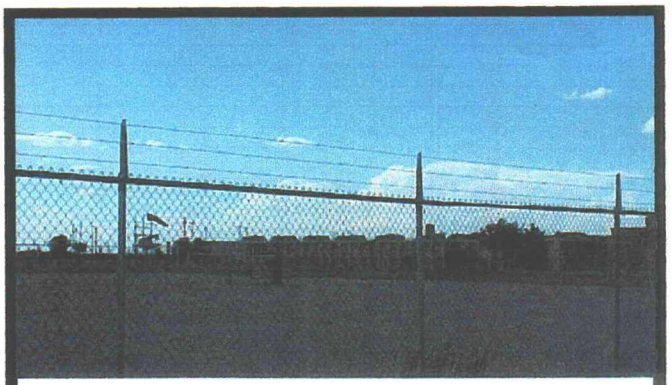
49 CFR Part 160– Federal Register Volume 55, # 226– Friday, November 23, 1990, page 48958, Center column, bottom 4 lines, ***"the 100 ppm H_2S in the gas stream, is used solely as a threshold criterion to identify those wells ad facilities which are subject to the requirements of this order. The criterion of 10 ppm of H_2S in ambient air applies to situations where protection of essential personnel and/ or the public health and safety is an issue."***
page 48964 of the same document, paragraph C. 3, c.
"Three commenters suggested that the threshold limits of the visual and audible alarms of 10 and 15 ppm respectively, were not appropriate, especially the 15 ppm level. The BLM recognizes the 20 ppm as used in industry and advocated by the American Petroleum Institute (API), however, to be consistent with the federal OSHA requirements, the BLM adopted the limits of 10 ppm time weighted average (TWA), and 15 ppm short term exposures for H_2S."

In the past, it has been assumed that H2S being a toxic gas, when inhaled by the human body at certain concentrations, causes certain physical effects. Once exhaled, the effects can correct themselves and go away. Recent research in this area however, indicates that this may very well be incorrect. I refer you to an article from the Houston Chronicle, 11/12/97, ***New Alarm Over H2S , Researchers Document Lasting Damage to the Human Nervous System;*** as well as an article taken from the Playa Del Rey California Business Wire, 6/11/01, ***Toxic Gas Threshold Believed Dangerously High in Playa Vista Report.***

Also enclosed, is a copy of a special report from the Houston Chronicle, entitled, **The Brimstone Battles**, which was a special report on H_2S and it deals with many of the current issues concerning H_2S between the public, those companies that produce H_2S, and the regulatory agencies charged with controlling exposures to H_2S and the public safety. When reviewing the section titled, **Denver City, Death Came From a Cloud**, keep in mind that Denver City, Texas, being a next door neighbor to the New Mexico communities of Lovington, Tatum, Hobbs and an adjacent county to Lea, but is also separated by that imaginary line that changes from Texas to NM. Please pay special attention to the article **Lost Opportunity, EPA Had it's Chance to Regulate H_2S**. H_2S issues in New Mexico are throughout this article as well. In the article from 11/8/97, **Locales Differ, But Similar Tales of Frustration Heard, Shouted Down in Artesia**, deals with the frustration of some of the citizens of our state and our own Environmental Department.

In short, we would like to see potentially hazardous volumes being no more than what has already been recognized as fatal and Immediately Dangerous to Life and Health (IDLH), that being 100 ppm or less. Keep in mind that the locations of H_2S producing wells, are not all located in

remote ranch areas, removed from the populous of New Mexico, but some of these are located immediately across the street from retirement homes, churches, hospitals, and some are even located in our school yards, where the future of New Mexico is in a "down wind" area from the well head. Many of these places, to knowingly allow them to fall within a 500 ppm radius of exposure before some sort of emergency corrective action is initiated, is negligent to the point of industrial murder. 100 ppm has been known to be a fatal dose. Dosage, being based on the reactions caused to a 150 healthy adult, when we equate that dosage back to the 50 pound 2nd grader in the New Mexico elementary school system, we must break it down to a per pound to body weight ratio. The 50 pound second grader has 1/3 of the body weight of a 150 pound adult, so the same physical effects caused to the adult by 100 ppm would appear in the 50 pound person at a concentration of 33 ppm , or 1/3 the adult dosage and the 100 ppm exposure would be 3 times as much as in an adult exposure. We cannot use a "one size fits all" dosage and expect to protect the worse case scenario. The same would apply to the senior citizens in the nursing homes who are already suffering from various circulatory and /or respiratory health problems.



Building in background is Jefferson Elementary School / Hobbs, New Mexico

Building in background is Merrill Gardens Retirement Home/ Hobbs, NM

Building in background is Good Samaritan Nursing Home / Hobbs, NM

What we would like to see, is that the point of where emergency action is to take place any time that H_2S is detected in a concentration of 100 ppm at the bell nipple or 10 ppm in ambient air, that immediate action will be initiated to control the release and contingency plans will be enacted to protect the workers and the general public. This is more in line with other requirements such as 39 CFR Part 3160 Onshore Oil and Gas Operations– Federal and Indian Oil & Gas Leases; Federal Register Volume 55, Part 226, Friday 11/23/90, page 48973, vii," *When H2S is detected in excess of 10 ppm at any detection point, red flags shall be displayed.* ***Corrective Action:*** *display red flag.* ***Normal abatement period:*** *Prompt Correction Required.;* ***e. Warning System Response.*** *When H_2S is detected in excess of 10 ppm at any detection point, all non-essential personnel shall be moved to a safe area and essential personnel [i.e., those necessary to maintain control of the well], shall wear pressure demand type breathing apparatus. Once accomplished, operations may proceed."*

RULE 52 , paragraph f, Signage at wells, facilities or operations. The paragraph states that this shall apply to every well, operation or system at which the concentration of Hydrogen Sulfide is 100 ppm or greater. In paragraphs 1, 2 & 3, the same wording appears, the signs shall read "DANGER—POISON GAS, HYDROGEN SULFIDE PRESENT" or as appropriate, " CAUTION– POISON GAS– HYDROGEN SULFIDE MAY BE PRESENT".

OSHA regulation 29 CFR 1910.145, which is based on ANSI Z535.2-1991, gives the requirements for color and format for three levels of Hazard Communications signs, those being "Danger", "Warning", and "Caution". It goes further to state, that **"DANGER"** is to be used to indicate that an immediate hazard exists that could cause death or serious injury. The wording and the symbol **"Caution",** is to be used to indicate that a potentially hazardous situation could cause minor or moderate injury. We feel the line **"Caution Poison Gas Hydrogen Sulfide Gas May be Present"** should be removed, due to the fact that the indication for minor or moderate injury is non-applicable when the sign is required at the H_2S level of 100 ppm, which is the established Immediately Dangerous to Life or Health (IDLH) concentration. We feel the appropriate sign would be the one meeting the ANSI description for format and reading,

"DANGER– POISON GAS– HYDROGEN SULFIDE".

The third area on page 8, c. Detection and monitoring equipment, i. Each drilling and completion site shall have a Hydrogen Sulfide detection and monitoring system that automatically activates visible and audible alarms when the ambient air concentration of Hydrogen Sulfide reaches 20 ppm. The level of 20 ppm is not in line with current industry standards. These alarms, by other federal regulations and company policies, are set to alarm at 10 ppm, which is the accepted permissible exposure limit. The decision to set the alarms at 10 ppm were based on an H2S Threshold Limit Value of 20 ppm, a point at which physical effects of H_2S poisoning is recognized to take place on the human body. It has been decided that action should be taken before the stage is reached allowing the physical effects to commence. If we wait until the physical effects manifest themselves, we have waited passed the point of being reasonable and prudent. We recommend that this paragraph be changed to read **"10 ppm"** instead of the 20 ppm.

Page 9, paragraph a, reading in part,..."*but is encountered during drilling in a concentration of 100 ppm or greater in the gaseous mixture is very unclear as to where this sample is to actually be taken. We would recommend that the wording,* "***but is encountered during drilling in a concentration level of 100 ppm or greater at the bell nipple"*** would be more clear and have the language of the industry as well as other regulations, the same being true in paragraph b in the line reading, " in excess of 100 ppm is encountered while drilling".

Paragraph d– "100 ppm in public areas, 500 ppm at any public road, or 100 ppm, 3000 feet from the site of release", these levels again are , way too high for the descriptions given. We can show you many places in southeastern NM where producing wells are located quite literally in the back yard, with residences located within 100 feet of the well head. These wells having levels of 10 ppm, 15 ppm and 50 ppm being levels that are known to cause negative effects on the human body, with many of these having flowlines that are located under the city streets and in the front and back yards of residences. For a producer not to be required to take corrective action on a leak located where at times, can be as little as 15 to 20 foot from Mrs. Brown's front door, until the level reaches 5 times the recognized IDLH concentration, is extreme negligence.

Page 10, paragraph i, Personal Protection & Training. *All persons being responsible for the implementation of any Hydrogen Sulfide contingency plan, shall be provided training in Hydrogen sulfide hazards, detection, personal protection and contingency procedures.* There is no provision for the training of personnel who work in and around potentially lethal Hydrogen Sulfide exposures. It only requires that people responsible for the contingency plans have such training. It is required by OSHA standards 29 CFR 1910.1200– Hazard Communications that... "all employees having the potential to come in contact with a hazardous substance be trained in the recognition of the hazardous substance , how to protect themselves from contact and how to respond to a hazardous release or chemical emergency." There has been a concern in the industry for many years as to the need for training to enable all workers to work safely in a potential H2S environment. It is for that reason, that the American National Standards Institute (ANSI) developed ANSI Z390– H2S Training Criteria. A draft copy of the standard is enclosed. It describes the minimum criteria that should be included in an H2S employee training course, which includes state and federal regulatory requirements. Section 3 Training Critera 3.1 Physical and Chemical Properties of H2S

3.2 Sources of H2S, 3.3 Human Physiology and Medical Evaluation 3.4 Work Procedures; 3.5 Personal Protective Equipment; 3.6 Use of Contingency Plans and Emergency Response; 3.7 Burning, Flaring and Venting of H2S; 3.8 State and Federal Regulator Requirements; 3.9 H2S Release, Dispersion Models; 3.10 Rescue Techniques, First Aid and Post Exposure Evaluations; 3.11 Methods of Detection and Monitoring; 3.12 Engineering Controls, 3.13 Transportation of Hydrogen Sulfide Cargos; 3.14 Emerging Technology

Section 4 Gives Instructor Qualifications and Proficiency

This is a very important area and is based upon even the best of instructors cannot pass along to the most receptive of students those things that he does not know himself. The instructor has a very important responsibility to make himself aware of all things relevent to the topic in order that he might be able to teach them to the students, especially when the topic is relevant to the students life and health.

Section 5 Describes how the training must be documented and how records must be kept.

Section 6 Described student competency and qualifications.

We have found that training meeting this criteria is of the utmost importance to ensure safe work practices in all work areas where H2S may be present. We would very much like to see wording in the new Rule 52 stating," *that all personnel involved in any type of H2S operations, both those personnel in the oil & gas industries as well as those people in law enforcement and public safety that may be included in H2S release contingency plans, be required to be trained in the hazards of H2S and that training shall , at a minimum, meet the requirements of ANSI Z390 H2S Training Criteria."*

We feel that this is a very important part of the rule, due to the fact that training in this area today in the oil and gas industry runs the full gambit from in-depth, high quality training courses down to in some cases, " *That stuff is pretty dangerous , so ya'll be careful".* We have found that in some cases as well, especially those in the public safety sector, such as volunteer fire departments, county sheriffs departments, etc., are going blindly into these emergency situations without any training whatsoever. Thank you for your time in allowing me to address this committee.

John w. Prather, SHS/CHSH/ES

unenforced Carol Parish said. public exchanges at City Hall See CHIEF, Page 5

HOBBS NEWS SUN
SEPTEMBER 10, 2002

AP PHOTO

...gers prepares ...7th Air Refuel- ...28. Rogers and the rest of the four-man crew had just finished their briefing for the mission refueling F-16 fighters patrolling against possible intruders.

...ten warriors?

U.S. troops fighting war against terrorism wonder if Americans are paying attention

SOMEWHERE OVER TEXAS (AP) — Alabama Air National Guard Master Sgt. Steve Hay is fighting the war on terror lying on his stomach more than four miles above Texas.

Hay, a lawyer whose budding career was sidetracked by the Sept. 11 terrorist attacks, will spend this night refueling F-16 fighters patrolling U.S. airspace.

Peering out a small window into the darkness, Hay maneuvers the fueling boom into a receptacle atop a fighter, flying about 20 feet below at 500 mph.

...eve ...efu-

On the ground below, Americans are sleeping and watching Jay Leno.

"They don't have any idea we're here," Hay, 34, said over the deafening roar of the engines.

That kind of disconnect between middle America and the fight against terrorism bothers Guard members including Hay, part of a four-person crew aboard the tanker. Sometimes it seems people are more worried about the stock market than al-Qaida, they say.

"The American public was real-

See WARRIORS, Page 5

H2S leak closes highways

NEWS SUN STAFF REPORT

Sections of Highway 18 and State Road 483 were closed Monday evening due to a possible hydrogen sulfide gas leak.

Lovington Police Department, New Mexico State Police and Lea County Sheriff's Department all responded to the scene and redirected traffic for more than an hour.

State Road 483 was closed two miles north and south of Stiles Road. State Highway 18 was closed for about an hour and traffic was re-directed to the Denver City Highway.

Lea County Sheriff's Department received a call from a Lovington city employee about a possible H2S gas leak at approximately 2:55 p.m. The Sheriff's Department then contacted state police.

A Lovington city employee was working in the area, when he saw a dead bobcat and several dead birds. Soon after, his air monitor alarms went off, and he left the area.

An unidentified Lovington city employee was taken to Nor-Lea General Hospital to be treated for high blood pressure related to H2S inhalation, according to City Manager Pat Wise.

"He's OK," Wise said. "He just got a little excited, that's all."

H2S, a toxic gas that smells like rotten eggs, is commonly found with sour crude oil and sour natural gas. Most oilfield personnel are equipped with air monitors to detect H2S, which in concentrations of 300 parts per million or more can be deadly.

Exposure to high amounts of H2S can result in irritability, disorientation and death. H2S is toxic because it instructs the brain to forget to tell the lungs to breathe. If CPR is not administered in four-six minutes of the person passing out, death is certain.

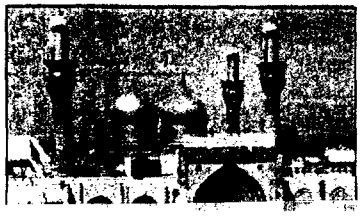
The cause of the pipeline gas leak is unknown at this time as well as the owner of the pipeline. At press time, the gas leak was being repaired.

...osition softening

demand that Iraq open weapons sites

...wary U.S. allies, ...or administration ...Bush planned to ... said.

The officials, speaking on con-



A giant painting of of Iraqi President Saddam Hussein stands at the entrance to ...

Hydrogen sulfide

IDLH Documentation

CAS number: 7783064

NIOSH REL: 10 ppm (15 mg/m^3) 10minute CEILING

Current OSHA PEL: 20 ppm CEILING, 50 ppm 10minute MAXIMUM PEAK

1989 OSHA PEL: 10 ppm (14 mg/m^3) TWA, 15 ppm (21 mg/m^3) STEL

1993-1994 ACGIH TLV: 10 ppm (14 mg/m^3) TWA, 15 ppm (21 mg/m^3) STEL

Description of Substance: Colorless gas with a strong odor of rotten eggs.

LEL:. . 4.0% (10% LEL, 4,000 ppm)

Original (SCP) IDLH: 300 ppm

Basis for original (SCP) IDLH: The chosen IDLH is based on the statements by Patty [1963] that 170 to 300 ppm is the maximum concentration that can be endured for 1 hour without serious consequences; 400 to 700 ppm is dangerous after exposure of 0.5 to 1 hour [Henderson and Haggard 1943]. AIHA [1963] reported that 400 to 700 ppm caused loss of consciousness and possible death in 0.5 to 1 hour [MCA 1950].

Existing short-term exposure guidelines: 1991 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG1: 0.1 ppm (60minute)

ERPG2: 30 ppm (60minute)

ERPG3: 100 ppm (60minute)

National Research Council [NRC 1985] Emergency Exposure Guidance Levels (EEGLs):

10minute EEGL: 50 ppm

24hour EEGL: 10 ppm

ACUTE TOXICITY DATA:

Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Back et al. 1972	713	-----	1 hr	977 ppm (1.37)	98 ppm
Mouse	Back et al. 1972	673	-----	1 hr	922 ppm (1.37)	92 ppm
Human	Lefaux 1968	-----	600	30 min	600 ppm (1.0)	60 ppm
Mouse	MacEwen and Vernot 1972	634	-----	1 hr	869 ppm (1.37)	87 ppm
Human	Tab Biol Per 1933	-----	800	5 min	354 ppm (0.44)	35 ppm
Rat	Tansey et al. 1981	444	-----	4 hr	1,141 ppm (2.57)	114 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.2 [ten Berge et al. 1986].

Other human data: It has been reported that 170 to 300 ppm is the maximum concentration that can be endured for 1 hour without serious consequences [Henderson and Haggard 1943] and that olfactory fatigue occurs at 100 ppm [Poda 1966]. It has also been reported that 50 to 100 ppm causes mild conjunctivitis and respiratory irritation after 1 hour; 500 to 700 ppm may be dangerous in 0.5 to 1 hour; 700 to 1,000 ppm results in rapid unconsciousness, cessation of respiration, and death; and 1,000 to 2,000 ppm results in unconsciousness, cessation of respiration, and death in a few minutes [Yant 1930].

Revised IDLH: 100 ppm

Basis for revised IDLH: The revised IDLH for hydrogen sulfide is 100 ppm based on acute inhalation toxicity data in humans [Henderson and Haggard 1943; Poda 1966; Yant 1930] and animals [Back et al. 1972; MacEwen and Vernot 1972; Tansey et al. 1981].

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This page was last updated : 8/16/96

Go back to the NIOSH home page or to the CDC home page.

Toxic Gas Threshold Believed Dangerously High in Playa Vista Report

PLAYA DEL REY, Calif.–(BUSINESS WIRE)–June 11, 2001–Amid challenges to the veracity of the city's recent Chief Legislative Analyst (CLA) Report on Health and Safety issues at the Playa Vista development, members of the medical and research community are urging the Los Angeles City Council to reconsider their active support for this development.

In testimony to Council Members Bernson and Hernandez at a meeting of the Public Land Use Management Committee on June 4, Professor John Montgomerie, M.D., Professor Emeritus of Medicine, USC School of Medicine, stated that the level of 10 parts per million (ppm) for Hydrogen Sulfide (H2S) referenced in the CLA Report as acceptable was 100 times higher than research studies indicate are safe.

"In recent years there have been an increasing number of studies showing that what was once considered a safe level of H2S is in fact very toxic to humans," Montgomerie said.

H2S is one of the most corrosive gases known to man and has been shown to cause brain damage in small children and sensitive adults at extremely low levels.

Montgomerie stated that the California Ambient Air Quality Standard (CAAQS) for H2S is 0.03 ppb (or 30 parts per billion), and the U.S. Environmental Protection Agency has developed a reference concentration of less than 1 part per billion.

"Dr. Kaye Kilburn, USC School of Medicine, has performed neurological tests that indicate damage at H2S levels as low as one part per million," Montgomerie continued. "And in a recently published study by Dr. Marvin Legator, Division of Toxicology, University of Texas, it was found that Hydrogen Sulfide at levels as low as 10 parts per billion may produce a range of disorders to the central nervous system."

Ten parts per billion is a 1,000-fold lower concentration of H2S than the 10 parts per million deemed acceptable in the CLA Report.

Dr. Paul Connett, professor of environmental chemistry and toxicology at St. Lawrence University, and researcher and international consultant in the areas of waste management and toxic issues, stated, "The hydrogen sulfide levels that have been reported at Playa Vista are of great concern from a health hazard point of view. Long-term consequences to the immune system is of particular concern to developing children.

"H2S is more toxic than Hydrogen Cyanide," Connett cautioned. "I urge the Los Angeles City Council to reject any and all attempts to develop areas which promise to generate hydrogen sulfide over an indefinite period of time."

The City Council has scheduled a vote on Tuesday, June 11, to release $33.6 million in low-cost housing construction bond funds and to consider the issuance of an estimated $400 million in Mello-Roos bonds to finance infrastructure for the Playa Vista developers.

CONTACT:

Grassroots Coalition, Los Angeles

Jeanette Vosburg, 310/636-3518

KEYWORD: CALIFORNIA

THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

7:50 PM 11/12/1997

New alarm over hydrogen sulfide

Researchers document lasting damage to human nervous system

By JIM MORRIS

INDIANAPOLIS -- Exposure to hydrogen sulfide, even in extremely low concentrations, can cause lasting damage to the nervous system, according to research presented here Wednesday, Nov. 12.

Members of a panel at the American Public Health Association's annual meeting discussed study results that challenge the conventional wisdom on the chemical, a highly toxic byproduct of oil and natural gas extraction and refining, as well as other industries. The thinking has been that if an exposure to hydrogen sulfide (H2S) isn't fatal, there are few, if any, lasting effects.

But in his presentation Wednesday, Dr. Kaye Kilburn, of the University of Southern California School of Medicine, said unequivocally that "H2S poisons the brain, and the poisoning is irreversible."

In recent years, Kilburn has studied workers subjected to relatively high doses of the chemical and residents of two California refinery communities -- San Luis Obispo and the Wilmington neighborhood of Los Angeles. Kilburn's subjects underwent extensive neurological testing and showed pronounced deficits in balance, reaction time and other characteristics tested. They also complained of recurring ailments such as dizziness, insomnia and overpowering fatigue.

Three Texas researchers who have just completed their analysis of data collected near a geothermal power plant in Hawaii reported similar findings.

Dr. Marvin Legator and Chantele Singleton, of the University of Texas Medical Branch in Galveston, administered a detailed "symptom survey" to 97 people who live within four miles of the Puna Geothermal Venture. PGV produces electricity from subsurface volcanic heat and gives off hydrogen sulfide in the process.

Eighty-eight percent of the subjects said they had experienced central nervous system impairment of the sort described by Kilburn.

Only 26 percent of those in a control group -- people who live some 20 miles from the plant -- reported such problems.

Dr. Bob Borda, a neuropsychologist in Stafford, put neighbors of the plant through a battery of tests and found that many demonstrated attention deficits and an inability to process information quickly. The condition, Borda said, is analogous to an outdated computer

program: It runs, but it is maddeningly slow and inefficient.

All of the findings presented Wednesday are significant because hydrogen sulfide is common and poorly regulated, as the Houston Chronicle reported in a series of articles earlier this week.

There remains a "tremendous information gap" regarding the chemical's chronic, low-level effects, said Legator, a toxicologist. He is convinced, however, that hydrogen sulfide is a "potent neurotoxin" that does lasting damage.

Adoption of Amendments to the Regulations

Accordingly, 26 CFR part 1 is amended as follows:

PART 1—INCOME TAXES

Paragraph 1. The authority citation for part 1 is amended by adding an entry in numerical order to read in part as follows:

Authority: 26 U.S.C. 7805 * * *
Section 1.42-16T also issued under 26 U.S.C. 42(n); * * *

Par. 2. Section 1.42-16T is added to read as follows:

§ 1.42-16T Eligible basis reduced by federal grants (temporary).

(a) *In general.* If, during any taxable year of the compliance period (described in section 42(i)(1)), a grant is made with respect to any building or the operation thereof and any portion of the grant is funded with federal funds (whether or not includible in gross income), the eligible basis of the building for the taxable year and all succeeding taxable years is reduced by the portion of the grant that is so funded.

(b) *Grants do not include certain rental assistance payments.* A federal rental assistance payment made to a building owner on behalf or in respect of a tenant is not a grant made with respect to a building or its operation if the payment is made pursuant to—

(1) Section 8 of the United States Housing Act of 1937;

(2) A qualifying program of rental assistance administered under section 9 of the United States Housing Act of 1937; or

(3) A program or method of rental assistance as the Secretary may designate through the Federal Register or in the Internal Revenue Bulletin (see § 601.601(d)(2) of this chapter).

(c) *Qualifying rental assistance program.* For purposes of paragraph (b)(2) of this section, payments are made pursuant to a qualifying rental assistance program administered under section 9 of the United State Housing Act of 1937 to the extent that the payments—

(1) Are made to a building owner pursuant to a contract with a public housing authority with respect to units the owner has agreed to maintain as public housing units (PH-units) in the building;

(2) Are made with respect to units occupied by public housing tenants, provided that, for this purpose, units may be considered occupied during periods of short term vacancy (not to exceed 60 days); and

(3) Do not exceed the difference between the rents received from a building's PH-unit tenants and a pro rata portion of the building's actual operating costs that are reasonably allocable to the PH-units (based on square footage, number of bedrooms, or similar objective criteria), and provided that, for this purpose, operating costs do not include any development costs of a building (including developer's fees) or the principal or interest of any debt incurred with respect to any part of the building.

(d) *Effective date.* This section is effective January 27, 1997.

Margaret Milner Richardson,
Commissioner of Internal Revenue.

Approved: January 8, 1997.

Donald C. Lubick,
Acting Assistant Secretary of the Treasury.

[FR Doc. 97-1790 Filed 1-24-97; 8:45 am]
BILLING CODE 4830-01-U

DEPARTMENT OF THE INTERIOR

Minerals Management Service

30 CFR Part 250

RIN 1010-AB50

Hydrogen Sulfide Requirements for Operations in the Outer Continental Shelf

AGENCY: Minerals Management Service (MMS), Interior.

ACTION: Final rule.

SUMMARY: This rule revises requirements for preventing hydrogen sulfide (H_2S) releases, detecting and monitoring H_2S and sulphur dioxide (SO_2), protecting personnel, providing visual and audible warnings, and training personnel. The rule also establishes requirements for H_2S flaring. The revisions are necessary to keep up with current practices and technologies, and to enhance personnel safety and environmental protection.

EFFECTIVE DATE: March 28, 1997.

FOR FURTHER INFORMATION CONTACT: E.P. Danenberger at (703) 787-1598 or John Mirabella at (703) 787-1600.

SUPPLEMENTARY INFORMATION: On May 11, 1995, we published in the Federal Register (60 FR 25178) a reproposed rule, which incorporated comments to a previous proposed rule which we published on August 15, 1990 (55 FR 33326). The reproposed rule incorporated the latest editions of two documents:

- American National Standard Institute (ANSI), American National Standard For Respiratory Protection (ANSI Z88.2-1992), and
- The National Association of Corrosion Engineers' (NACE) Standard (MR-01-92), Recommended Practice (RP), Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment.

We received a total of three responses: one from the National Institute of Safety and Health (NIOSH) and two from industry. We have addressed their comments below and have rewritten the rule in a clearer and more user-oriented style. We have subdivided some sections. As a result, some sections have been renumbered.

Discussion of Comments

Comment: NIOSH referred to recommendations it had given to the Occupational Safety and Health Administration with respect to "bearded workers" and "wearing contact lenses," and recommended that the pressure-demand-type respirator required should be certified by NIOSH.

Response: We have incorporated by reference the ANSI Z88.2 standard that addresses the topics of "bearded workers" and "wearing of contact lenses." We believe our rule is consistent with regulations promulgated by other Federal agencies but do not agree that certification by other agencies is needed.

Comment: There is a critical need for a system that would continuously monitor and detect any emissions the instant they occur at wellheads and manifolds.

Response: We consider the sensors that detect the presence of H_2S in air to be part of a continuous monitoring system. Sensor locations take into consideration design factors such as type of decking, location of fire walls, ventilation, or area confinement. Alternative monitoring systems may be desirable for production systems that have components which are prone to erosion and leaks. MMS encourages lessees to use new or alternative monitoring systems that enhance leak detection capabilities.

Comment: Delete the requirements concerning SO_2-detection and monitoring equipment. The commenter stated that a properly designed flare system, coupled with general requirements allowing operators to establish personnel exposure limits, should be adequate for personnel protection on a facility.

Response: We agree that operators should be permitted to propose alternatives to the use of portable of fixed SO_2 monitors to monitor air quality while burning gas containing H_2S. We added a provision to allow the District Supervisor to consider and

approve alternative engineering controls.

Comment: The requirement concerning training for visitors who stay *overnight* on a facility should be given to visitors who remain *2 consecutive* nights. The suggested wording would eliminate unnecessary detailed training for office associates and other visitors who infrequently visit the facility. The commenter also recommended the substitution of the phrase "abbreviated training program" with the word "briefing."

Response: We agree with the commenter that "overnight" is not an appropriate criteria. We have modified the requirement to provide more flexibility by allowing stays of up to 24 hours.

Comment: Expand the requirement concerning resuscitators by adding the words: "on manned facilities and a number equal to the personnel on board, not to exceed three, on unmanned facilities." The suggested words would indicate that it is not necessary to maintain or provide three resuscitators in facilities where there are less than three persons.

Response: We agree and used the suggested words, with modifications.

Comment: Change the requirement of drills for each person within 24 hours after duty begins and at least once during every subsequent 7-day period be changed to say: "A drill will be conducted for each person at the facility during his or her normal duty." The commenter felt that drills for each person within 24 hours after duty begins is an unnecessary administrative burden due to varied work rotations. Also, in order to indicate that H_2S drills and training can be conducted as part of other drills, the following words be inserted: "H_2S drills and training may be conducted in conjunction with other safety meetings or with rig/facility abandonment drills."

Response: We agree with the suggestion concerning drill frequency and used the suggested words, with modifications. Lessees may combine H_2S drills with other training or drills if scenarios are realistic and the drill procedures effectively prepare personnel for an H_2S emergency.

Comment: Expand the operational danger signs requirement by adding the words: "and/or red flashing lights be illuminated." The commenter observed that the proposed rule permits use of electronic systems. However, the actual language of the proposed rule did not include such provisions. The use of flashing lights may be more effective than flags.

Response: We agree. The suggested words, modified to say, "and/or activate flashing red lights," will be inserted in the requirement.

Comment: Clarify sensor locations in enclosed areas in order to avoid contradictory interpretations.

Response: We agree. We have modified that requirement.

Comment: Expand the requirement concerning the use of detectors in nearby facilities by adding the words: "To invoke this requirement the District Supervisor will consider dispersion modeling results from a possible release to determine if 20 parts per million (ppm) H_2S concentration levels could be exceeded at nearby facilities." The added language would explain the decision process used to invoke the requirement of having monitoring equipment at third party sites.

Response: We agree and used the suggested words with modifications.

Comment: Reduce the nominal breathing time of "at least 15 minutes" for respirators to "at least 5 minutes." The commenter states that experience from drills indicate that a 5 minute nominal breathing time is adequate for a trained user to reach a safe briefing area, and that the cited ANSI document does not specify a 15 minute normal breathing time for this application.

Response: We do not agree with the commenter. We feel that the risk of entering or exiting an H_2S atmosphere that is immediately dangerous to life or health warrants the use of a self-contained air supply as recommended in Section A.9.1.3 of ANSI Z88.2-1992, i.e., a supply of 15 minutes or more. Commenters responding to our previously proposed rule published in the Federal Register on August 15, 1990, requested that we specify a self-contained breathing time. We decided to specify a nominal breathing time of at least 15 minutes because 5 minutes might now allow personnel enough time to escape from an emergency.

Comment: Insert the words "upon request of the Regional Supervisor" in the recordkeeping requirements concerning monthly reports of flared and vented gas containing H_2S as required in § 250.175(d)(3). Some regions are under control of local authorities concerning air pollution and require submission of such reports, making the report to MMS optional. The suggested changes would provide local MMS offices with the authority to require this report only as needed and avoids duplication.

Response: The suggested words will be inserted in the section. On May 20, 1996, a final rule modified § 250.175. In consequence, the paragraphs contained in that section were renumbered. Thus, § 250.175(d)(3) became § 250.175(f)(3).

Author: Mario Rivero, Information and Training Branch, prepared this document.

Executive Order (E.O.) 12866

This final rule does not meet the criteria for a significant rule requiring review by the Office of Management and Budget (OMB) under E.O. 12866.

Regulatory Flexibility Act

This proposed amendment to the rule will not have any significant effects on a substantial number of small entities. In general, the entities that engage in offshore activities are not small due to the technical and financial resources and experience needed to safely conduct such activities. Small entities are more likely to operate onshore or in State waters—areas not covered by the proposed rule. When small entities do work in the OCS, they are likely to be contractors. Working in an H_2S environment can be dangerous, and it is important that all operators and contractors follow the rules. Small entities that work on the OCS have been able to comply with existing rules and will be able to comply with the new rules. These changes to the rules will not affect their ability to compete.

Paperwork Reduction Act

MMS has submitted to OMB for approval the information collection requirements in this final rule which revises § 250.67 (OMB Control Number 1010-0053) and adds § 250.175(f) (OMB Control Number 1010-0041). On February 6, 1996, we provided a 60-day review and comment process through a notice in the Federal Register (61 FR 4480). The Paperwork Reduction Act of 1995 provides that an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

The titles of the collections of information are "30 CFR Part 250, Subpart D, Oil and Gas Drilling Operations" (1010-0053) and "30 CFR Part 250, Subpart K, Oil and Gas Production Rates" (1010-0041).

The collections of information in this final rule consist of the reporting and recordkeeping necessary to prevent H_2S releases, protect human safety, and detect and monitor SO_2. They include critical contingency plan requirements; recordkeeping on training, drilling, and equipment monitoring activities; posting of safety, emergency and warning procedures; and MMS reporting requirements. Responses are mandatory.

MMS needs the information to ascertain the condition of a drilling site and to determine if lessees are properly providing for the safety of operations and protection of human life or health and the environment. We use the information to avoid and eliminate hazards inherent in drilling operations.

The respondents are approximately 26 Federal oil and gas lessees. The frequency of response is "on occasion."

In § 250.67, we estimate an annual reporting burden of 849 hours and an annual recordkeeping burden of 16,189 hours. In § 250.175(f), we estimate an annual reporting burden of 432 hours. The burden estimates include the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Send comments regarding the burden or any other aspect of the collections of information contained in § 250.67 and § 250.175(f), including suggestions for reducing the burdens, to the Office of Information and Regulatory Affairs, Office of Management and Budget, Attn: Desk Officer for the Department of the Interior, Room 10102, 725 17th Street, NW., Washington, DC 20503 (OMB control number 1010–0053 or 1010–0041). Send a copy of your comments to the Information Collection Clearance Officer, Minerals Management Service, Mail Stop 2053, 381 Elden Street, Herndon, Virginia 20170–4817.

Takings Implication Assessment

The DOI determined that this final rule does not represent a governmental action capable of interference with constitutionally protected rights. Thus, DOI does not need to prepare a Takings Implication Assessment pursuant to E.O. 12630, Governmental Actions and Interference with Constitutionally Protected Property Rights.

E.O. 12988

The DOI certified to OMB that the rule meets the applicable reform standards provided in Sections 3(a) and 3(b)(2) of E.O. 12988.

Unfunded Mandates Reform Act of 1995

The DOI has determined and certifies according to the Unfunded Mandates Reform Act, 2 U.S.C. 1502 *et seq.*, that this rule will not impose a cost of $100 million or more in any given year on State, local, and tribal governments, or the private sector.

National Environmental Policy Act

The DOI determined that this action does not constitute a major Federal action significantly affecting the quality of the human environment; therefore, an Environmental Impact Statement is not required.

List of Subjects in 30 CFR Part 250

Continental shelf, Environmental impact statements, Environmental protection, Government contracts, Incorporation by reference, Investigations, Mineral royalties, Oil and gas development and production, Oil and gas exploration, Oil and gas reserves, Penalties, Pipelines, Public lands—minerals resources, Public lands—rights-of-way, Reporting and recordkeeping requirements, Sulphur development and production, Sulphur exploration, Surety bonds.

Dated: January 9, 1997.

Sylvia V. Baca,

Deputy Assistant Secretary, Land and Minerals Management.

For the reasons stated in the preamble, Minerals Management Service (MMS) amends 30 CFR part 250 as follows:

PART 250—OIL AND GAS AND SULPHUR OPERATIONS IN THE OUTER CONTINENTAL SHELF

1. The authority citation for part 250 continues to read as follows:

Authority: 43 U.S.C. 1334.

2. In § 250.1, paragraphs (c)(7) and (g)(1) are revised to read as follows:

§ 250.1 Documents incorporated by reference.

* * * * *

(c) * * *

(7) ANSI Z88.2–1992, American National Standard for Respiratory Protection, Incorporated by Reference at: §§ 250.67(g)(4)(iv) and (j)(13)(ii).

* * * * *

(g) * * *

(1) NACE Standard MR.01–75–96, Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment, January 1996, Incorporated by Reference at: § 250.67(p)(2).

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3. In § 250.2, the definitions for *Zones known to contain H_2S*, *Zones where the absence of H_2S* has been confirmed, and *Zones where the presence of H_2S* is unknown are removed.

4. Section 250.67 is revised to read as follows:

§ 250.67 Hydrogen sulfide

(a) *What precautions must I take when operating in an H_2S area?* You must:

(1) Take all necessary and feasible precautions and measures to protect personnel from the toxic effects of H_2S and to mitigate damage to property and the environment caused by H_2S. You must follow the requirements of this section when conducting drilling, well-completion/well-workover, and production operations in zones with H_2S present and when conducting operations in zones where the presence of H_2S is unknown. You do not need to follow these requirements when operating in zones where the absence of H_2S 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_2S absent means:

(1) Drilling, logging, coring, testing, or producing operations have confirmed the absence of H_2S in concentrations that could potentially result in atmospheric concentrations of 20 ppm or more of H_2S; or

(2) Drilling in the surrounding areas and correlation of geological and seismic data with equivalent stratigraphic units have confirmed an absence of H_2S throughout the area to be drilled.

H_2S present means that drilling, logging, coring, testing, or producing operations have confirmed the presence of H_2S in concentrations and volumes that could potentially result in atmospheric concentrations of 20 ppm or more of H_2S.

H_2S unknown means the designation of a zone or geologic formation where neither the presence nor absence of H_2S 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_2S.* You must:

(1) Request and obtain an approved classification for the area from the Regional Supervisor before you begin operations. Classifications are "H_2S absent," H_2S present," or "H_2S 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_2S that could

potentially result in atmospheric concentrations of 20 ppm or more in areas not previously classified as having H_2S present, you must immediately notify MMS and begin to follow requirements for areas with H_2S 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_2S Contingency Plan.* Before you begin operations, you must submit an H_2S Contingency Plan to the District Supervisor for approval. Do not begin operations before the District Supervisor 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_2S 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_2S alert. You must have at least two briefing areas on each facility and use the briefing area that is upwind of the H_2S 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 facilities by boat, helicopter, or lifeboat. If you use helicopters during H_2S alerts, describe the types of H_2S 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_2S (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_2S;

(11) The medical personnel and facilities you will use if needed, their addresses, and telephone numbers;

(12) H_2S detector locations in production facilities producing gas containing 20 ppm or more of H_2S. Include an "H_2S Detector Location Drawing" showing:

(i) All vessels, flare outlets, wellheads, and other equipment handling production containing H_2S;

(ii) Approximate maximum concentration of H_2S in the gas stream; and

(iii) Location of all H_2S sensors included in your contingency plan;

(13) Operational conditions when you expect to flare gas containing H_2S including the estimated maximum gas flow rate, H_2S 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_2)-detection system(s) you will use to determine SO_2 concentration and exposure hazard when H_2S is burned;

(18) Increased monitoring and warning procedures you will take when the SO_2 concentration in the atmosphere reaches 2 ppm;

(19) Personnel protection measures or evacuation procedures you will initiate when the SO_2 concentration in the atmosphere reaches 5 ppm;

(20) Engineering controls to protect personnel from SO_2; 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 operators and contract personnel must complete an H_2S 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_2S 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_2S and SO_2; and

(B) Instructions on their responsibilities in the event of an H_2S 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_2S and of SO_2 and the provisions for personnel safety contained in the H_2S Contingency Plan;

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

(iii) Location of protective breathing equipment, H_2S detectors and alarms, ventilation equipment, briefing areas, warning systems, evacuation procedures, and the direction of prevailing winds;

(iv) [illegible] measures concerning beards, spectacles, and contact lenses in conformance with ANSI Z88.2;

(v) Basic first-aid procedures applicable to victims of H_2S exposure. During all drills and training sessions, you must address procedures for rescue and first aid for H_2S 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_2S* 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_2S considerations at the facility, and other updated H_2S 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_2S and on facilities that process gas containing H_2S 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_2S reaches 20 ppm.

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

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_2S," 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_2S.

(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_2S-detection and H_2S monitoring equipment.*—(1) *What are the requirements for an H_2S detection system?* An H_2S detection system must:

(i) Be capable of sensing a minimum of 10 ppm of H_2S in the atmosphere; and

(ii) Activate audible and visual alarms when the concentration of H_2S 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);

(iv) Shale shaker;

(v) Well-control fluid pit area;

(vi) Driller's station;

(vii) Living quarters; and

(viii) All other areas where H_2S may accumulate.

(3) *Do I need mud sensors?* The District Supervisor 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_2S.

(4) *How often must I observe the sensors?* During drilling, well-completion and well-workover operations, you must continuously observe the H_2S 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_2S 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_2S 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_2S 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_2S 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

require additional sensors or other monitoring capabilities, if warranted by site specific conditions.

(6) *How must I functionally test the H_2S Detectors?*

(i) Personnel trained to calibrate the particular H_2S detector equipment being used must test detectors by exposing them to a known concentration in the range of 10 to 30 ppm of H_2S.

(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_2S present or H_2S 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_2S 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 Supervisor may require that H_2S-detection and H_2S-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 MMS personnel.

(9) *What are the requirements for nearby vessels?* If vessels are stationed overnight alongside facilities in areas of H_2S present or H_2S unknown, you must equip vessels with an H_2S-detection system that activates audible and visual alarms when the concentration of H_2S 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_2S Contingency Plan.

(10) *What are the requirements for nearby facilities?* The District Supervisor may require you to equip nearby facilities with portable or fixed H_2S detector(s) and to test and calibrate those detectors. To invoke this requirement, the District [illegible] consider dispersion modeling results from a possible release to determine if 20 ppm H_2S concentration levels could be exceeded at nearby facilities.

(11) *What must I do to protect against SO_2 if I burn gas containing H_2S?* You must:

(i) Monitor the SO_2 concentration in the air with portable or strategically placed fixed devices capable of detecting a minimum of 2 ppm of SO_2;

(ii) Take readings at least hourly and at any time personnel detect SO_2 odor or nasal irritation;

(iii) Implement the personnel protective measures specified in the H_2S Contingency Plan if the SO_2 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_2.

(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_2S present or H_2S 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 to conform to ANSI Z88.2, American National Standard for Respiratory Protection.

(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 Supervisor may require additional protective-breathing equipment on certain vessels attendant to the facility.

(viii) During H_2S alerts, limit helicopter flights to and from facilities to the conditions specified in the H_2S Contingency Plan. During authorized flights, the flight crew and passengers must use pressure-demand-type respirators. You must train all members of flight [illegible] 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_2S detectors capable of detecting a 10 ppm concentration of H_2S 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_2S or SO_2 may accumulate; and

(iii) Provide movable ventilation devices in work areas. The movable ventilation devices must be multidirectional and capable of dispersing H_2S or SO_2 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_2S release?* You must [illegible] of a gas release which results in a 15-minute time weighted average atmospheric concentration of H_2S of 20 ppm or more anywhere on the facility.

(m) *Do I need to use special drilling, completion and workover fluids or procedures?* When working in an area classified as H_2S present or H_2S unknown:

(1) You may use either water- or oil-base muds in accordance with § 250.40(b)(1).

(2) If you use water-base well-control fluids, and if ambient air sensors detect H_2S, you must immediately conduct either the Garrett-Gas-Train test or a

comparable test for soluble sulfides to confirm the presence of H_2S.

(3) If the concentration detected by air sensors in 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_2S, well-control fluid pH, and corrosion equipment.

(i) *Scavengers.* You must have scavengers for control of H_2S available on the facility. When H_2S 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_2S 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_2S and other gases must be through pressurized or atmospheric mud-separator equipment depending on volume, pressure and concentration of H_2S. 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_2S and restore and maintain the proper quality.

(o) *Well testing in a zone known to contain H_2S.* When testing a well in a zone with H_2S 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_2S 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_2S 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_2S, you must activate SO_2 monitoring equipment in accordance with paragraph (j)(11) of this section. If you detect SO_2 in excess of 2 ppm, you must implement the personnel protective measures in your H_2S Contingency Plan, required by paragraph (f)(13)(iv) of this section. You must also follow the requirements of § 250.175. 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_2S service.

(5) Use tubulars suitable for H_2S service. You must not use drill pipe for well testing without the prior approval of the District Supervisor. Water cushions must be thoroughly inhibited in order to prevent H_2S 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_2S service.

(p) *Metallurgical properties of equipment.* When operating in a zone with H_2S 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_2S 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_2S service.

(2) Use BOP system components, wellhead, pressure-control equipment, and related equipment exposed to H_2S-bearing fluids that conform to NACE Standard MR.01-75-96.

(3) Use temporary downhole well-security devices such as retrievable packers and bridge plugs that are designed for H_2S service.

(4) When producing in zones bearing H_2S, 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_2S zone*—(1) *Coring operations.* When you conduct coring operations in H_2S-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_2S.

(2) *Logging operations.* You must treat and condition well-control fluid in use for logging operations to minimize the effects of H_2S 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_2S reaches 20 ppm or if the well is under pressure.

(4) *Gas-cut well-control fluid or well kick from H_2S-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 mut 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_2S 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_2S and CO_2) 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_2S exists.

(8) *Wireline lubricators.* Lubricators which may be exposed to fluids containing H_2S must be of H_2S-resistant materials.

(9) *Fuel and/or instrument gas.* You must not use gas containing H_2S for instrument gas. You must not use gas containing H_2S for fuel gas without the prior approval of the District Supervisor.

(10) *Sensing lines and devices.* Metals used for sensing line and safety-control devices which are necessarily exposed to H_2S-bearing fluids must be constructed of H_2S-corrosion resistant materials or coated so as to resist H_2S corrosion.

(11) *Elastomer seals.* You must use H_2S-resistant materials for all seals which may be exposed to fluids containing H_2S.

(12) *Water disposal.* If you dispose of produced water by means other than subsurface injection, you must submit to the District Supervisor an analysis of the anticipated H_2S content of the water at the final treatment vessel and at the discharge point. The District Supervisor may require that the water be treated for removal of H_2S. The District Supervisor may require the submittal of an updated analysis if the water disposal rate or the potential H_2S content increases.

(13) *Deck drains.* You must equip open deck drains with traps or similar devices to prevent the escape of H_2S 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_2S is present.

5. In § 250.175, the section heading is revised and paragraph (f) is added to read as follows:

§ 250.175 Flaring or venting gas and burning liquid hydrocarbons.

* * * * *

(f) *Requirements for flaring and venting of gas containing H_2S—(1) Flaring of gas containing H_2S.* (i) The Regional Supervisor may, for safety or air pollution prevention purposes, further restrict the flaring of gas containing H_2S. The Regional Supervisor will use information provided in the lessee's H_2S Contingency Plan (§ 250.67(f)), Exploration Plan or Development and Production Plan, and associated documents in determining the need for such restrictions.

(ii) If the Regional Supervisor determines that flaring at a facility or group of facilities may significantly affect the air quality of an onshore area, the Regional Supervisor may require the operator(s) to conduct an air quality modeling analysis to determine the potential effect of facility emissions on onshore ambient concentrations of SO_2. The Regional Supervisor may require monitoring and reporting or may restrict or prohibit flaring pursuant to §§ 250.45 and 250.46.

(2) *Venting of gas containing H_2S.* You must not vent gas containing H_2S except for minor releases during maintenance and repair activities that do not result in a 15-minute time weighted average atmospheric concentration of H_2S of 20 ppm or higher anywhere on the platform.

(3) *Reporting flared gas containing H_2S.* In addition to the recordkeeping requirements of paragraphs (d) and (e) of this section, when required by the Regional Supervisor, the operator must submit to the Regional Supervisor a monthly report of flared and vented gas containing H_2S. The report must contain the following information:

(i) On a daily basis, the volume and duration of each flaring episode;

(ii) H_2S concentration in the flared gas; and

(iii) Calculated amount of SO_2 emitted.

[FR Doc. 97-1465 Filed 1-24-97; 8:45 am]
BILLING CODE 4310-MR-M

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 52

[WA7-1-5542; WA38-1-6974; FRL-5675-7]

Approval and Promulgation of State Implementation Plans; Washington

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: The Environmental Protection Agency (EPA) is approving portions of Washington State Implementation Plan revision submittals for particulate matter for the Spokane and Wallula, Washington, particulate matter nonattainment areas. EPA is also granting temporary waivers of the attainment date for both areas. This action extends the attainment date for particulate matter air pollution from December 31, 1994, to December 31, 1997, in both nonattainment areas. The granting of the temporary waivers will provide the Washington Department of Ecology (Ecology) time to complete technical evaluations of the anthropogenic and nonanthropogenic sources of windblown dust in the area. The purpose of the submitted revisions is to bring about the attainment of the national ambient air quality standards (NAAQS) for particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}). The implementation plans were submitted by Ecology to satisfy certain federal Clean Air Act requirements for an approvable moderate PM_{10} nonattainment area SIPs for Spokane and Wallula, Washington.

EFFECTIVE DATE: March 28, 1997.

ADDRESSES: Written comments should be addressed to: Montel Livingston, SIP Manager, EPA, Office of Air Quality (OAQ 107), 1200 Sixth Avenue, Seattle, Washington 98101.

Copies of the State's request and other information supporting this proposed action are available for inspection during normal business hours at the following locations: EPA, Office of Air Quality, 1200 Sixth Avenue (AT-082), Seattle, Washington 98101, and State of Washington Department of Ecology, 300 Desmond Drive, Lacey, Washington 98503.

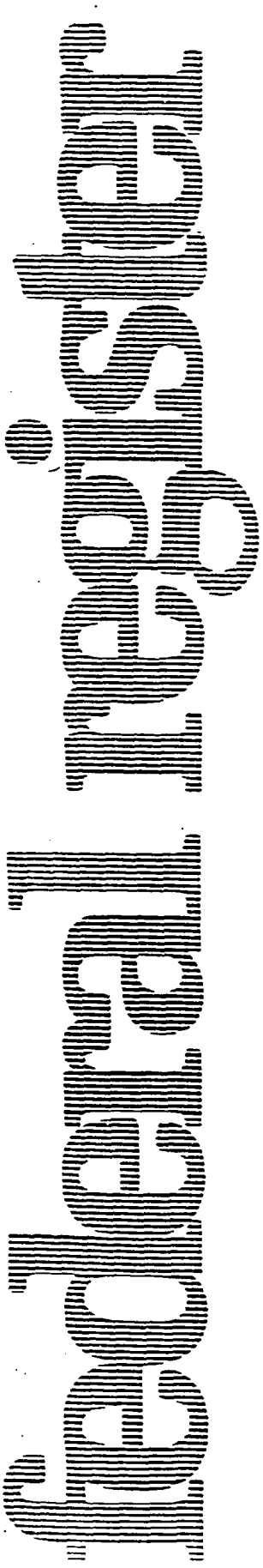
FOR FURTHER INFORMATION CONTACT: George Lauderdale, Office of Air Quality (AT-082), EPA, Region 10, Seattle, Washington 98101, (206) 553-6511.

SUPPLEMENTARY INFORMATION:

I. Background

The Spokane and Wallula, Washington areas were designated nonattainment for PM_{-10} and classified as moderate under sections 107(d)(4)(B) and 188(a) of the Clean Air Act, upon enactment of the Clean Air Act Amendments of 1990.[1] See 56 FR 56694 (November 6, 1991). The air quality planning requirements for moderate PM_{10} nonattainment areas are set out in subparts 1 and 4 of Part D, Title I of the

[1] The 1990 Amendments to the Clean Air Act made significant changes to the Act. See Pub. L. No. 101-549, 104 Stat. 2399. References herein are to the Clean Air Act, as amended ("the Act"). The Clean Air Act is codified, as amended, in the U.S. Code at 42 U.S.C. sections 7401, *et seq.*



Friday
November 23, 1990

Part II

Department of the Interior

Bureau of Land Management

43 CFR Part 3160

Onshore Oil and Gas Operations; Federal and Indian Oil and Gas Leases; Onshore Oil and Gas Order No. 6, Hydrogen Sulfide Operations; Final Rule

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

CFR Part 3160

[AA-610-00-4111-02; Circular No. 2630]

RIN 1004-AA67

Onshore Oil and Gas Operations; Federal and Indian Oil and Gas Leases; Onshore Oil and Gas Order No. 6, Hydrogen Sulfide Operations

AGENCY: Bureau of Land Management, Interior.

ACTION: Final rule.

SUMMARY: This final rule provides for the issuance of Onshore Oil and Gas Order No. 6, Hydrogen Sulfide Operations, which implements and supplements the provisions of 43 CFR 3162.1, 3162.5-1, 3162.5-2, and 3162.5-3. The purpose of this order is to protect public health and safety and those personnel essential to maintaining control of the well. This Order addresses the requirements for conducting operations in a hydrogen sulfide environment. Specifically, it identifies the necessary applications, approvals, and reports required to conduct hydrogen sulfide operations and where necessary, the components required for a Public Protection Plan. It identifies the specific operating requirements for conducting drilling, completion, workover, and production operations in a hydrogen sulfide environment. In addition, this Order details enforcement actions and allows for variances from the specific standards. This final rule also amends 43 CFR 3164.1, Onshore Oil and Gas Orders, paragraph (b).

EFFECTIVE DATE: January 22, 1991.

ADDRESSES: Inquiries or suggestions should be sent to: Director (610), Bureau of Land Management, Premier Building, Room 601, 1849 C Street NW., Washington, DC 20240.

FOR FURTHER INFORMATION CONTACT: Sie Ling Chiang, (202) 653-2133, or Chris Hanson, (414) 297-4421.

SUPPLEMENTARY INFORMATION: A proposed rule for issuing Onshore Oil and Gas Order No. 6, Hydrogen Sulfide Operations, was published in the Federal Register on May 16, 1989 (54 FR 21075), with a 60-day comment period. An extension for submission of comments until July 31, 1989, was granted and published July 24, 1989 (54 FR 30766). Comments were received from 12 sources, including 2 industry associations, 5 industrial entities, and 5 government entities.

Several changes and additions were made in the definitions section for clarification in response to the comments. Changes were also made in the requirements section in response to comments.

Those comments relating directly to the proposed rule have been grouped by subject matter and will be discussed as a group rather than individually.

General Comments

One commenter suggested that drilling operations be discussed separately in the Order and that completions and workovers be discussed with production operations. This Order has delineated those provisions in the drilling section which have specific applicability to completions and workovers. In addition, the minimum standards identified for all operations will remain the same regardless of organizational format. Therefore, this suggestion was not adopted.

It was recommended that a discussion of the Forest Service's (FS) role in the Public Protection Plan should be presented in this Order. The Mineral Leasing Reform Act of 1987 did not grant any specific authority in this regard to the FS. The regulations that pertain to the FS under that Act were published on March 21, 1990 (55 FR 10423). These regulations acknowledge that compliance is required with applicable Onshore Oil and Gas Orders issued by the Department of the Interior, Bureau of Land Management (BLM) as specified under 36 CFR 228.112(c)(7). The requirement for a Public Protection Plan to be included in this Order is pursuant to BLM's regulatory authority set forth in 43 CFR 3161.2. The BLM assumes the primary role and responsibility for Public Protection Plans. In the development of a Public Protection Plan, however, the operator should consider the role of the FS where the agency is the primary Federal land manager. For operations where the FS is the surface managing agency, all plans required by this Order will be forwarded to the FS along with the applicable parts of the submitted Application for Permit to Drill in accordance with existing regulations, policy and procedures.

One commenter stated that the threshold criteria throughout the Order of 100 ppm of H_2S in the gas stream and 10 ppm of H_2S in the ambient air is confusing. The following is an explanation of the provision. In addition, the wording has been changed in Sections III.A.1. and III.C.1.c. for further clarification. The 100 ppm H_2S in the gas stream is used solely as a threshold criterion to identify those wells and facilities which are subject to the requirements of this Order. The criterion of 10 ppm of H_2S in the ambient air applies to situations where protection of essential personnel and/or the public health and safety is an issue. The Drilling Operations Plan is implemented at 500 feet above the first potential H_2S zone or 3 days prior to penetrating the first identified H_2S formation (whichever comes first) for all wells subject to this Order. In addition, if 10 ppm of H_2S in the ambient air is indicated at any of the sensing points, additional measures will be taken. It should be noted that the 10 ppm of H_2S in the ambient air is not used as a factor in determining which wells and/or facilities are subject to this Order.

One commenter stated that the BLM does not have any means of routinely verifying the threshold criterion of 100 ppm H_2S in the gas stream to ensure that all wells which meet the criterion are properly subjected to the requirements of this Order. The BLM conditionally accepts many types of data from oil and gas operators with respect to wells on Federal and Indian oil and gas leases. However, the BLM reserves the right to conduct or require an independent analysis of the gas.

Two comments were received regarding the limits of the authorized officer's discretionary authority with respect to enforcement where major isolations exist. This Order supplements the existing oil and gas operating regulations (43 CFR 3160), and the discretionary authority is defined throughout 43 CFR 3163. Further, the introductory paragraph in section III of this Order has been rewritten to clarify this authority and additional guidance will be provided to the BLM's authorized officers via internal manuals.

It was suggested that all specific references to Onshore Order No. 1 be removed. The BLM agrees with this recommendation since Order No. 1 is currently being revised. However, general references to Onshore Order No. 1 have been retained in this rulemaking because various provisions are applicable to Order No. 6.

One commenter suggested that the status of H_2S and SO_2 under the Comprehensive Environmental Resource Compensation and Liability Act (CERCLA) should be discussed. CERCLA specifically exempts natural gas. The Environmental Protection Agency has considered all constituents of natural gas, such as H_2S and SO_2 as meeting this exemption. Therefore, the comment was not adopted.

One commenter felt that it is undesirable for the BLM to classify the severity of each violation, state the

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corrective action, and specify the normal abatement period in the Order. The oil and gas industry and its associations have indicated in numerous meetings with BLM representatives that they would like to know how the BLM will generally view non-compliances and the normal enforcement actions. Therefore, based on this consideration, the BLM has decided to incorporate these provisions in all its Onshore Oil and Gas Orders.

It was recommended that this rule be made effective at least 60 days after the date of publication to provide operators adequate notice. This suggestion has been adopted.

Specific Comments

I.A. Authority

One commenter contended that the terms of this Order should be promulgated either as an amendment to 43 CFR part 3162 or as an appendix to 43 CFR part 3160 so that it would be included in the Code of Federal Regulations. The commenter stated that publication of an Order results in redundancy and inconsistency, but did not identify any inconsistency. No redundancy or inconsistency has been found. As authorized by 43 CFR 3164.1, this Order implements and supplements the requirements of 43 CFR part 3162. It is being properly promulgated through the notice and comment procedures of the Administrative Procedures Act. The Code of Federal Regulations makes reference to the Order's existence and location in the Federal Register. Technical requirements of this type are more appropriately addressed in an Onshore Oil and Gas Order than in general regulations.

One commenter stated that to track the enabling statutes, this Order should take the form of operating guidelines with suggested violation levels, rather than strictly enforceable minimum standards. The commenter did not cite any provisions in the enabling statutes that prohibit the Secretary of the Interior from promulgating strictly enforceable minimum standards. The statutes cited in the authority section of this Order give broad rulemaking authority to the Secretary (See especially 30 U.S.C. 187 and 189). Numerous Orders imposing such minimum standards have been promulgated. Onshore Oil and Gas Orders No. 2 through 5 also contain strictly enforceable minimum standards with specified violation levels.

One commenter contended that the BLM lacks statutory authority to assess strict liability type penalties under 43 CFR 3163.1. The BLM did not propose any revision of 43 CFR 3163.1 in the current rulemaking; so no response is required. The commenter is referred to the preamble in the final rule promulgating 43 CFR 3163.1 published February 20, 1987 (52 FR 5384).

I.B. Purpose

Two commenters suggested that the BLM should enter into a Memorandum of Understanding (MOU) with the Federal Occupational Safety and Health Administration (OSHA) regarding protection of "essential personnel" to avoid confusion. The BLM has coordinated with OSHA in the development of this Order and both agencies agree that no conflict or overlap exists. The references to "essential personnel" in the Order are for control of the well (43 CFR 3162.5–2) and for protection of public health and safety (43 CFR 3162.5–3). An MOU is not necessary for either agency to implement regulations pertaining to their respective authorities, and therefore, this suggestion was not adopted.

The phrase referring to enforcement actions was removed and the wording changed to be consistent with the provisions contained in the Order. It is not the intent of this Order to specify enforcement actions, but rather the gravity of violations, probable corrective actions, and the normal abatement period for each requirement.

I.C. Scope

Two commenters recommended that the Order provide for a specific exclusion from the minimum standards for "remote facilities" where human life or property would not be in jeopardy. They further indicated that if an exclusion is not provided, operators would routinely request variances from minimum standards for such wells which would create unnecessary paperwork for the operator and the BLM. The purpose of the Order is to ensure control of the well and hence a conservation of the hydrocarbon resource as well as to protect public health and safety. The Order requires only a drilling operations plan for such "remote" wells and, in general, a variance from those minimum standards would not be granted.

One commenter stated that the Order should apply to Indian Mineral Development Agreements. The BLM provides technical assistance to the Bureau of Indian Affairs in the review and enforcement of these agreements. The BLM is presently developing a policy to address its operational responsibilities concerning such documents and the applicability of this Order.

It was also suggested that the Order should not apply to wells in unit agreements including American Petroleum Institute (API) unit agreements, except for those drilled on Federal or Indian lands. The applicability of this Order will be consistent with the provisions containe in individual agreements and the agency's current policy regarding the jurisdiction and enforcement of all oil and gas operating regulations for non-Federal wells committed to such agreements.

For consistency with the changes made in response to the comments on Section III.B.2.b.ii.(e), the words "or property" have been removed from the first sentence.

II. Definitions

Several comments indicated that confusion existed in use of the terms "release * * * that may endanger the public" and "potentially hazardous volume". For clarification, the term "release . . . that may endanger the public" has been removed and references are now made to the term "potentially hazardous volume" which has been defined in Section II. of the Order. The ambient air concentrations identified in this definition are derived through radius of exposure calculations and are used to determine if a potentially hazardous volume of H_2S exists.

It was recommended that a definitior be included for the term "remote facilities" based on a suggested language change in the Requirements section of the Order. It is not prudent to classify wells subject to the Order by virtue of their distance from public facilities. Therefore, the suggestion was not adopted.

Authorized Representative. This term was not necessary for this Order and was removed. As a result, several definitions have been redesignated in the final rule.

Escape Rate. One commenter suggested a language change for item 1 of this definition. Such language was redundant to the criteria used in the definition of "Radius of exposure" and, therefore, was not adopted.

Two commenters felt that the use of "absolute open flow rate" (AOF) for an entire production facility was unreasonable while five commenters fe that it was unreasonable to use this standard in calculating the escape rate for a gas well. For drilling wells, the fiv commenters suggested alternative language of "maximum wellhead deliverability against zero back pressure." One commenter suggested

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that the operator should be allowed a choice of methods to calculate the escape rate for wells. It was also suggested that a new subcategory be developed for exploratory wells. The BLM recognizes the commenters' desire for flexibility, but believes that its obligation for the protection of public health and safety is an overriding concern. Therefore, the agency used a more conservative approach in calculating the escape rate by using an AOF determination for individual wells and the maximum daily gas handling volumes for production facilities. One commenter suggested that the operator should be given a choice of methods to calculate the "escape rate" in developed areas. The commenter is referred to the definition which allows the operator to use data from offset wells in lieu of calculations, if satisfactory to the authorized officer.

Essential Personnel. It was suggested that the term "essential personnel" be removed since non-essential personnel may be required to stay at their station when H_2S is present. The definition of "essential personnel" indicates that persons who have a necessary function when H_2S is present, would be classified as "essential personnel." Further, the Order states that all personnel shall be trained and that non-essential personnel shall be moved to a safe area once 10 ppm of H_2S in the ambient air is reached any detection point. Therefore, this gestion was not adopted.

Two commenters indicated that OSHA rules adequately cover essential personnel. This Order augments OSHA requirements in that it provides for the protection of essential personnel from the standpoint of maintaining control of the well for the purposes of public health and safety and conservation of the hydrocarbon resources.

Three commenters recommended that all Government personnel, including the BLM's inspectors, be subject to the same training and provisions of this Order as apply to "essential personnel." Inspectors are considered non-essential personnel for purposes of this Order. However it is BLM policy that they be properly trained and equipped prior to inspecting H_2S operations.

Gas Well. It was suggested that this definition be consistent with other BLM policy. This suggestion was adopted and the definition changed accordingly.

H_2S Drilling Operations Plan. Three commenters suggested that this term be changed to "H_2S Contingency Plan" to be consistent with other BLM regulations and Orders. The citation in the regulations at 43 CFR 3162.5–1(d) is general in nature and is supplemented by this Order. Therefore, no change is necessary. The references to H_2S Contingency Plan in Order No. 1 have been removed and replaced by H_2S Drilling Operations Plan and Public Protection Plan, as applicable. Requiring only a Drilling Operations Plan and, when necessary, a Public Protection Plan will save submission of unnecessary paperwork and is more definitive in nature.

Major Violation and *Minor Violation.* It was suggested that the violations be incorporated as guidelines only. The commenter is referred to the BLM's previous response under Section I.A. of this preamble. Two commenters recommended that a "moderate" violation level be incorporated to better utilize the authorized officer's discretionary authority and to avoid upgrading minor violations to major ones. It is the intent of the BLM to upgrade minor violations to major where warranted. The BLM has determined that it will classify violations as either major or minor as defined in 43 CFR 3160.0–5. For further justification regarding violation levels, the commenter is referred to the preamble of the final rule implementing the Federal Oil and Gas Royalty Management Act published on February 20, 1987 (52 FR 5384).

Oil Well. It was suggested that this definition be consistent with other BLM policy. This suggestion was adopted and the definition changed accordingly.

Production Facilities. For consistency with BLM policy, the words "for royalty purposes" have been removed and replaced with "approved measurement point."

Prompt Correction. It was suggested that immediate correction of all alleged noncompliances should not be required, but that many "discrepancies could be safely delayed." The inclusion of this standard is necessary to resolve those noncompliance actions which cause or threaten immediate, substantial and adverse impacts on public health and safety. Therefore, this comment was not adopted.

Radius of Exposure. One commenter pointed out that use of different methods and calculations using the Pasquill-Gifford equation for the 100 and 500 ppm radii of exposure results in different radii of exposures. The BLM recognizes this and provides for use of other models if approved by the authorized officer. The operator would be required to demonstrate the applicability and acceptability of the model to the situation. Three commenters indicated that there is a high degree of variability in air quality models recommended for use when the H_2S concentration exceeds 10 percent. One of the commenters suggested that the Pasquill-Gifford equation coupled with the other assumptions is so conservative that it could not be applied to concentrations in excess of 10 percent, and that section II.S.3. should be removed. Another commenter questioned how one of a series of models is to be selected. The BLM agrees that there is a high degree of variability between models, and therefore the operator has the option to utilize the model most applicable to the specific situation. The EPA's "Guidelines on Air Quality Models—(EPA–450/2–78–027R)" is intended to assist operators in this selection. The BLM does not agree that the Pasquill-Gifford equation is extremely conservative, but rather that its assumptions become less valid at concentrations in excess of 10 percent in stable atmospheres. Therefore, the suggestion to remove section II.S.3. was not adopted. Alternative wording was also suggested for section II.S.3. so that the operator would not be limited to those models contained in the EPA publication previously referenced. This suggestion was adopted and the language incorporated into the Order.

III. Requirements

In reference to the opening paragraph, two commenters suggested that the discretionary authority of the authorized officer be limited. One of the commenters suggested that the authorized officer's authority to require measures that vary from the minimum standards in the Order be amended to require the mutual consent of the operator. The BLM assumes a regulatory role in setting the minimum standards and this rulemaking process provides for operator input. These are minimum standards that would apply on a national basis. The authorized officer will rely on staff for any additional requirements deemed necessary on a local or geographic basis and if warranted, issue a Notice to Lessees (NTL) pursuant to 43 CFR 3164.2. All additional requirements would be subject to review pursuant to 43 CFR 3165.3. Therefore, the suggestion was not adopted. However, for purposes of clarity, the introductory paragraph in section III. was rewritten.

A.1. Several commenters suggested that when there are multiple filings for wells in a single field, the operator should be allowed to submit one Drilling Operations Plan, supplemented by the well site diagram for each well as required in Onshore Oil and Gas Order No. 1. The BLM agrees that this would save paperwork for both the operator and the authorized officer. This

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suggestion was adopted and expanded to include Public Protection Plans.

One commenter suggested that except where a general populace alert program is being used, the BLM should not require a Public Protection Plan for approval, but rather have the operator certify that one will be prepared and in place prior to the provisions of III.C.1.b. going into effect. The BLM has a regulatory responsibility to ensure that reasonable and prudent measures to protect public health and safety are in place before approving any action within its authority. Implementation of the suggested procedure would not fulfill that responsibility.

It was suggested that the following be required in the Drilling Operations Plan: duties, responsibilities, and procedures to be initiated at various H_2S concentrations; procedures for evacuation of personnel; agencies to be notified; and a list of medical personnel and facilities. The duties, responsibilities, and procedures for H_2S concentrations are required in section III.C.; the procedures for personnel evacuation in section III.C.3.e.; and the agencies to be notified in section III.A.3.b. of the Order. The requirements for medical personnel and facilities are covered by OSHA regulations and are not within the BLM's authority.

The scope of this section was expanded to include the BLM's intent that a single Public Protection Plan may also be submitted for a lease, communitization agreement, unit or field where applicable. To eliminate redundancy, the phrase "and the APD shall not be approved by the authorized officer" was removed from the last sentence of the first paragraph.

A.1.a. Several commenters stated that the requirement to include a statement of certification unnecessarily extends the normal contractor/operator working relationships and suggested alternative wording. The BLM agrees that certification is unnecessary since the contractor is obligated to provide such training and the operator is responsible for securing a written statement in accordance with the requirements of this Order. The phrase "of certification" has been removed from the provision.

A.1.b. Four commenters questioned the requirement of a map showing the terrain of the area surrounding the well site. It was suggested that the requirement be removed or that reference be made to Onshore Oil and Gas Order No. 1 which requires submission of a topographic map. Knowledge of the surrounding terrain is critical to evaluation of the H_2S Drilling Operations Plan. However, if the topographic map submitted in accordance with Order No. 1 is of sufficient clarity, scale and coverage, it would suffice in meeting this requirement. One commenter suggested that due to the long lead time between approval and actual drilling, the operator be allowed to submit two diagrams. The BLM agrees in part with this recommendation. If conditions change from the time an APD containing the initial diagram is approved to the time of actual drilling, a Sundry Notice with a revised diagram reflecting the necessary changes can be submitted for approval.

One commenter suggested that weather/seasonal changes be listed in this requirement. The dispersion models are conservative and deal with most temperature and weather conditions. In addition, the authorized officer may request additional information, when necessary. Therefore, this suggestion was not adopted. The same commenter suggested that "essential personnel" be specifically identified here and that all rig personnel be treated equally in the Order. The BLM is responsible only for those personnel necessary for well control (i.e., essential personnel) and OSHA is responsible for general worker safety. Therefore, the operator should have the latitude to determine which category of personnel are necessary to meet the minimum safety standards. It was also suggested that a requirement to include the location of permanent sensors and audible/visual alarms be identified here. The commenter is referred to section III.C.3.c. which specifically requires the location for such equipment.

A.1.c. Four commenters questioned the need for a complete description of the H_2S equipment/systems. They felt that it would be a burdensome submission of information. The BLM partially addressed this concern by removing the words "and their use." It is the BLM's intent for the operator to provide a complete description of specific equipment/systems required in the Order because such a description is necessary for the authorized officer to properly evaluate the acceptability of the H_2S Drilling Operations Plan to fulfill the BLM's public health and safety responsibilities.

Two commenters questioned the requirement for remote controlled chokes on all drilling wells. The BLM considers this equipment necessary for timely and efficient well control so as to minimize the release of H_2S. In areas where there are known low volume/low pressure reservoirs, variances should be requested by the operator.

Three commenters suggested that the word "permanent" in section III.A.1.c.iii. be changed. The BLM agrees that this word is not appropriate since the duration of drilling operations is short term.

It was recommended that the heading "Mud program" be changed to "Mud program and scavengers". Scavengers are a type of additive which is included in the subsection. Such a change would be repetitive and therefore, was not adopted.

A.2.a. Two commenters suggested that the operator simply calculate the radii of exposure and advise the authorized officer when the criteria in Section III.B.1. have been exceeded rather than submit the calculations. The BLM considers this information necessary to identify all facilities subject to this Order and ensure compliance with the required radius of exposure calculation methods. It is the BLM's intent to review the submission on a timely basis. Therefore, this suggestion was not adopted.

It was suggested that the respective time periods of 180 days and one year for submission of radii exposure calculations and a Pacific Protection Plan for each existing production facility be significantly shortened. The BLM considers these time periods as being reasonable and consistent with the operational equipment requirements specified in section III.D. of the Order. The commenter also suggested that the time period of 60 days for submission of a Public Protection Plan for a new production facility, where applicable, should be increased. The BLM considers 60 days to be adequate time for the preparation and submission of this plan. The 60-day requirement is also commensurate with timeframes required by the BLM for other plans (e.g. site security plans).

Two commenters suggested that water flowlines be excluded from the calculations required in this paragraph. The BLM agrees and this change has been made in the final rule.

A.2.b. Two commenters suggested various timeframes for the operator to submit an H_2S component gas analysis for each well to the authorized officer. The authorized officer has the authority under 43 CFR 3162.4–2 to require tests when necessary.

A.2.c. Several commenters stated that the notification requirement for unspecified changes in H_2S concentration or the radius of exposure was not reasonable and suggested various limitations and timeframes. The BLM agrees in part and the requirement has been changed to apply only when increases of 5 percent or more of the H_2S concentration or radius of exposure

occurs over that initially required under sections III.A.2.a. and III.A.2.b. of the Order. The 60-day requirement for notification is considered reasonable and has been retained.

A.3.b. Three commenters questioned the meaning of the phrase "that may endanger the public" and suggested alternate wording. The BLM agrees in part and replaced it with "a potentially hazardous volume" which has been defined in the Order. In addition, for purposes of clarity, the phrase "accidental release" has been changed to "any release". One commenter stated that the notification requirement is redundant with the requirements of the Superfund Amendments and Reauthorization Act (SARA), Title III. SARA, Title III does not ensure that the authorized officer will be notified and, therefore, this requirement has been retained. Two commenters questioned the need to elaborate on subsequent violations. The BLM agrees and such wording has been removed. One commenter suggested that the violation be major. The BLM is primarily concerned with adequate operator implementation of the Public Protection Plan and control of the H_2S upon detection of a release that may affect public health and safety rather than a notification requirement that does not directly affect public health and safety. Therefore, this suggestion was not adopted. It was also recommended that criteria for reporting and the category of violation be tied to the severity of the release similar to the criteria in the current Notice to Lessees—3A. Since public endangerment is the primary criteria and not necessarily the volume of release, this suggestion was not adopted.

For purposes of consistency with the definition of "potentially hazardous volume", the term "SO_2" has been removed from this requirement. Requirements regarding SO_2 are addressed in other sections of this Order. SO_2 is not associated with ordinary release of H_2S unless H_2S is ignited. However, the BLM does not intend by deleting this reference to imply that SO_2 is not potentially hazardous.

B.1. One reviewer felt that the phrase "and special precautions taken" in the introductory paragraph is superfluous. The BLM agrees and the phrase has been removed.

It was recommended that a single Public Protection Plan be required where wells and facilities exceeded an unspecified minimum level or are located within ¼ mile of a public place. The Order provides for a single plan in section III.B.2. The recommended criteria would be more stringent than the proposed minimum standard and radii of exposure is a more reasonable criterion for public safety than distance alone. Therefore, this suggestion was not adopted.

One commenter suggested that an exception to public notification be written into Public Protection Plans and accepted where releases of H_2S are common (e.g., plant upsets). Any releases resulting in H_2S levels as defined under "potentially hazardous volume" constitute a public hazard and warrant public notification. Therefore, this suggestion was not adopted.

It was recommended that the phrase "or other areas where the public could reasonably be expected to frequent" as used in this section and other sections of the Order be changed to "or other public areas that can expect to be populated". No reason was provided and the phrase did not appear to improve clarity. Therefore it was not adopted.

B.2.a.i. Several commenters were received suggesting that the phrase "potentially hazardous release" be changed or defined. The BLM agrees and the phrase has been changed to "potentially hazardous volume". In addition, the term "SO_2" has been removed for consistency with the definition of "potentially hazardous volume".

For purposes of consistency with section III.A.1. and to clarify the BLM's intent, the phrase "For production" has been removed from the beginning of the second sentence.

B.2.a.ii. One commenter felt that release of a potentially hazardous volume of H_2S should not be classified as a violation. The Order does not provide for a violation for the incidental release of H_2S because it could occur at anytime beyond the operator's control. However, the Order does provide that, upon detection of such a release, the operator is responsible for implementing the Public Protection Plan in order to protect public health and safety. Failure to implement this plan in the event of a release constitutes a violation. The same commenter suggested that the operator should have strong input in the Public Protection Plan. Since the operator is responsible for preparing the plan, he/she is the primary contributor to the document.

The term "SO_2" has been removed for consistency with the definition of "potentially hazardous volume".

B.2.a.iii. One commenter suggested that the abatement period for workover operations be changed to 24 hours. The BLM agrees and has adopted this recommendation.

B.2.b.i. One commenter suggested that the second sentence of this paragraph be removed and wording added in the following section to allow the use of general populace alert plan as is used in Texas. Another commenter felt that the wording was ambiguous. It is the BLM's intent that alternate plans may be used and latitude for alternatives is provided in the existing wording. However, if the operator proposes to use a populace alert plan only, a variance should be requested. Further, the language provides latitude to the operator to submit an adequate plan in areas of high population density, given the variety of conditions that may occur nationwide.

B.2.b.ii.(b) Four commenters suggested the use of "exposed to H_2S concentrations of 100 ppm" in this provision since the term "area of exposure" is not defined. The suggestion was adopted in part and the wording changed to "the 100 ppm radius of exposure". For clarity, the phrases "those responsible for safety of public roadways" and " as defined by the applicability criteria in section III.B.1." were incorporated into the first sentence. Two commenters suggested removing the last sentence, since the operating provisions of the Order provide adequate protection for nearby residents, while another commenter felt that the requirement was not stringent enough to provide adequate public protection. The BLM agrees that adequate public protection measures are provided in other sections of the Order, and therefore the sentence has been removed.

B.2.b.ii.(e) One reviewer recommended that the words "by visit or letter" be added after the words "Advance briefing". This suggestion was adopted and modified to read "Advance briefings, by visit, meeting, or letter . . ." Several commenters suggested that the phrase "or things that may be endangered" be removed from the end of the section since one of the primary purposes of the Order is to protect the public. The BLM agrees and it has been removed.

B.2.b.ii.(g) In order to clarify the BLM's intent to provide protection from the hazards of SO_2 and for consistency with section III.C.4.a.iv., a reference to SO_2 monitoring has been added for inclusion in the Public Protection Plan.

C.1. One commenter expressed confusion over the applicability of the 100 ppm in the gas stream criterion and the 20 ppm ambient concentration and stated that the Order appears to differ from the criteria specified in Onshore Oil and Gas Order No. 2. The reviewer is directed to the General Comments

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section of this preamble for clarification on the applicability criteria. The 10 ppm ambient concentration for taking measures to protect personnel is based on the revised OSHA criteria published in the Federal Register on January 19, 1989 (54 FR 2490). For consistency, the BLM will make appropriate changes to Order No. 2.

It was suggested that the Drilling Operations Plan be available at the well site only when operations are actually being conducted. The BLM agrees and the words "during operations" have been added to this section. The section has been further expanded to make clear when the operator is subject to this requirement.

C.1.b. One commenter disagreed that H_2S training should be completed and equipment be made operational at 500 feet above or 3 days prior to the first potential H_2S zone while another commenter endorsed the requirement, but suggested that the violation be classified as minor. It is critical that operating personnel be adequately trained a reasonable amount of time prior to the date it is expected that H_2S will be encountered so that they can respond competently and quickly to protect public health and safety. The BLM considers the requirement reasonable and that the violation classification for failure to take these measures is consistent with the definition of "major".

It was recommended that the caveat of "or the atmospheric concentration of H_2S reaches 10 ppm" be added to the criteria in this section. The 100 ppm criterion is used solely for determining which wells are subject to the provisions of this Order, and should not be confused with the ambient standards to which the operator is subject once the Order is in effect. Since this section deals with the basic applicability of the Order rather than ambient concentration, this suggestion was not adopted.

It was recommended that the phrase "unless detrimental to well control" be removed from subsection i. The BLM believes that situations do exist where shutting the well in may be detrimental to well control, which is one of the primary lines of defense to prevent a release of a hazardous volume of H_2S gas. Therefore, the suggestion was not adopted.

One reviewer suggested that for consistency, the time periods for notifying the authorized officer as used in this section should be stated in terms of business days. The BLM agrees and the wording has been changed in subsection iii. Time periods for corrective actions are properly stated as hours or calendar days.

Two commenters suggested that the authorized officer be authorized to approve interim resumption of operations prior to the requirements being met in this section where the operator can show that adequate safeguards are being employed to protect the public. It was recommended that the words "general populace alert plan" also be inserted here. The BLM considers the minimum standards to be reasonable. In addition, the authorized officer may approve resumption of drilling operations in emergency situations, or a variance could be requested by the operator. Therefore, these suggestions were not adopted.

C.2.a. Two commenters disagreed that two means of egress should be required at all well sites. The BLM considers this requirement important to maximize safe egress from drilling and completion sites. The Order provides for only one road and a foot path when a secondary road is not practical. Three commenters suggested that the violation should be changed from major to minor. The Bureau agrees with this recommendation since failure to meet this requirement does not meet the criteria for a major violation as defined in this Order.

C.2.b. Two reviewers suggested that the violation be changed from major to minor. The BLM agrees with this recommendation since failure to meet this requirement does not meet the criteria for a major violation as defined in this Order.

Two commenters stated that secondary escape routes are just as important in workover operations as they are for drilling and completion operations. The BLM believes that more unknown factors such as H_2S concentration, pressures, and flow rates exist in drilling and completion operations and therefore, require more safety contingencies.

C.3.a. One commenter reiterated earlier concerns that the BLM is establishing recommended practices as enforceable regulations here. The commenter is referred to the discussion in this preamble on section 1.A.

Three commenters suggested that the requirement to "certify" training of all personnel be removed for various reasons related to contract relationships and numerous suggestions for alternate wording were made. The BLM recognizes the potential contractual problems associated with the word "certify" and has replaced it with the word "ensure".

Two commenters suggested that the training requirements should apply only to essential personnel. The BLM believes that all personnel working around H_2S should be trained although additional provisions are made for "essential" personnel. Therefore, this suggestion was not adopted.

One commenter questioned the jurisdiction of this Order since specific operations were not listed. This Order extends to the same operations that are subject to the oil and gas regulations contained in 43 CFR part 3160.

It was suggested that the phrase "or its equivalent" in subsection i. be removed. No rationale was provided and since the driller's log recommended by the International Association of Drilling Contractors is not used in all geographic areas, this suggestion was not adopted.

It was recommended that the violation in subsection iii. be changed from major to minor. The BLM agrees with this recommendation since failure to meet this requirement does not meet the criteria for a major violation as defined in this Order.

C.3.b.i. Several commenters suggested that the word "ensure" be changed to "require" for various reasons relating to the operator's ability to oversee subcontractors. It is the BLM's intent that the word "ensure" as used in this Order means that an operator will mointor contractor/subcontractor operations on site such that they meet the minimum standards as set forth in this Order. Therefore, this suggestion was not adopted.

It was recommended that the word "shall" be changed to "must" with respect to providing a breathing apparatus for the derrickman. The word "shall" means that it is required, and therefore this suggestion was not adopted. It was also suggested that provisions for a line from a cascade system be added here. The Order does not preclude the use of this system. However, the BLM considers this proposal to be unreasonable as a minimum standard. Therefore, this suggestion was not adopted.

One commenter suggested that the Order specifically require the use of "pressure-demand type" breathing apparatus. The cited standard (ANSI) Z88.2-1980) includes this requirement as well as other standards for this equipment. This standard sufficiently describes the requirements; however, this section of the Order was modified to clarify that all working equipment must be a pressure-demand type.

The first sentence of this requirement was modified to clarify that the curent edition of the ANSI standard is applicable.

C.3.b.ii. It was recommended that breathing apparatus be required for all personnel. The BLM believes that a prudent operator will provide equipment for all personnel, but as a minimum standard, given the BLM's limited authority, it will be required for essential personnel only.

C.3.b.iii. Two commenters suggested that the violation for a lack of communication devices should be changed from major to minor. The BLM considers communication essential to the proper implementation of a Drilling Operations and/or Public Protection Plan. Since communication has a direct bearing on public health and safety, the violation of major was retained.

C.3.c. Three commenters suggested that the threshold limits for the visual and audible alarms of 10 and 15 ppm, respectively, were not appropriate, especially the 15 ppm level. The BLM recognizes the standard of 20 ppm as used in industry and advocated by the American Petroleum Institute. However, to be consistent with the Federal OSHA requirements, the BLM adopted the limits of 10 ppm time-weighted average and 15 ppm short-term exposure for H_2S.

It was recommended that a sensor be required in the cellar in lieu of the bell nipple, and that a sensor be placed in the mud house. It is logical that H_2S would break out at the bell nipple and be sensed earlier than in the cellar itself. A sensor at the bell nipple should sense any H_2S breaking out of the mud before it reaches the shale shaker. Therefore, this suggestion was not adopted.

One commenter suggested that a requirement for a public address system be added. This requirement may be appropriate for confined operations but not in unconfined areas such as the majority of onshore locations. The majority of onshore locations do not have camp facilities associated with the drilling operation, and for those that do, the authorized officer may require such a provision on a site-specific basis. Further, the briefing areas provide a place for communication with workers. Therefore, this suggestion was not adopted. The same commenter also stated that testing of the monitoring equipment to manufacturer's standards was not appropriate since it would allow the manufacturer to determine testing and calibration standards. The BLM currently considers the manufacturer's recommended standards to be reasonable as minimum standards for testing. Another commenter suggested that the Order incorporate calibration standards. BLM agrees and modified the text to include the calibration of H_2S detection and monitoring equipment in accordance with the manufacturer's recommendation. Also, the Minerals Management Service of the Department of the Interior is conducting an evaluation of calibration frequencies. BLM will consider the results of this evaluation and possibly develop calibration frequency standards. Any alternative methods of calibration or suggestions regarding calibration frequency requirements may be sent to the Director of BLM at the address specified in the beginning of this preamble.

C.3.d. One commenter suggested that the wind direction indicators be placed at the briefing areas since they may not be visible if the light plant fails. This possibility was considered, and the present wording "shall be visible at all times" provides the operator with latitude to meet this requirement on a site-specific basis. Therefore, this suggestion was not adopted.

Two commenters suggested that it may be necessary to have two signs posted on the access routes leading to a drilling site to allow large vehicles or those with trailers adequate time and space to turn around safely. This suggestion was adopted in part and the provision has been amended to allow vehicles adequate opportunity to turn around prior to reaching the well site.

Two commenters expressed concern as to the requirement for bilingual or multilingual signs. One commenter questioned the authorized officer's knowledge to determine where such a requirement is appropriate and the other requested that the current, in-place signs be accepted or grandfathered to minimize economic impacts to industry. The authorized officer is aware of those areas where bilingual or multilingual signing would be appropriate and the number of areas is considered to be minimal. Therefore, the economic impact would be minimal.

Several commenters stated that the requirement to have essential personnel put on their masks, move non-essential personnel, and display red flags when 10 ppm of H_2S is detected at any sensing point was unnecessarily restrictive. The commenters further suggested alternative wording. The BLM believes that such measures are essential to ensure adequate well control and public health and safety. The BLM agrees with one reviewer that operations should be allowed to proceed once these measures are implemented. This recommendation was incorporated by separating part of the language from section 3.C.d.vii and placing it into the new section 3.C.e. which provides for securing the area and allowing operations to proceed once non-essential personnel have been moved and essential personnel have donned protective breathing apparatus. One commenter suggested that this requirement only be applicable to detection points as required by the Order. The BLM believes that any prudent operator will not ignore readings from any detection point which indicates a problem. These requirements are minimum standards, and inspection and enforcement will be in accordance with the approved Application for Permit to Drill. Therefore, this suggestion was not adopted.

C.3.e. For purposes of clarity, the phrase "an area secured and conditions are below 10 ppm" has been removed and replaced with the word "accomplished".

C.4.a. It was suggested that well testing and swabbing during completion and workover operations should be specifically discussed and the operator should be granted more flexibility. The BLM believes there is little basic difference in operating procedures here and that the minimum standards are applicable to workovers and completions. Furthermore, where differences do exist, they have been stated. Therefore, this suggestion was not adopted.

C.4.a.i. Several commenters disagreed that the use of a mud system should be the minimum standard for drilling, completions, and workovers. All commenters contended that aerated mud and non-mud systems can be used in some situations, primarily in low-pressure H_2S zones. The BLM recognizes that these situations exist. However, in the interest of public health and safety, the use of mud systems as the minimum standard is considered appropriate. The operator may request a variance in those cases cited by the commenters.

C.4.a.ii. Two commenters suggested that this provision be amended to read "where operating pressures are sufficient". Neither commenter provided any rationale for their suggestion and the term "sufficient" is ambiguous. The existing wording as a minimum standard meets the intent of protecting public health and safety.

C.4.a.iii. Three commenters suggested that the flare line lengths should be changed to 100 feet to be consistent with Order No. 2. Flare lines of 150 feet are considered reasonable for H_2S locations due to the additional risk involved and that larger locations may be necessary. The BLM does not agree that this provision needs to be consistent with Order No. 2 since the two Orders deal with different conditions. Therefore, this suggestion was not adopted.

C.4.a.v. Two commenters felt that this requirement was unnecessary and that the violation should not be major. The BLM considers that this measure is reasonable for the protection of public health and safety and that the potential hazard to the public if it is violated is significant. Therefore, the violation gravity of major is appropriate.

C.4.a.vi. It was suggested that the wording be changed to require SO_2 monitoring equipment only when there is a reasonable expectation that the public may be exposed to 2 ppm or greater of SO_2. It is the BLM's intent that this provision include "essential personnel" who are necessary for well control as well as the public. Therefore, this suggestion was not adopted.

One commenter stated that the 2 ppm SO_2 level should not be a threshold, but a continuous level. It is the BLM's intent that the minimum standards used in this Order are for sustained levels. In addition, the reference to 2 ppm or greater of SO_2 in parentheses was removed since it was unnecessary.

C.4.a.vii. One commenter pointed out that the BLM did not use any SO_2 applicability criteria in determining when a public protection plan is to be submitted. The BLM used only H_2S concentration in developing the applicability criteria, but recognizes that SO_2 results from flaring the H_2S and is hazardous. Therefore, keying solely on H_2S also includes safety measures for SO_2 as a burned by-product of H_2S.

C.4.a.viii. Three commenters suggested that the requirement for a remote controlled choke for all operations was unnecessary and made various suggestions as to the conditions in which it should be required, including specific pressures, abnormal pressures, or proximity to public areas. In addition, it was suggested that the violation gravity be changed from major to minor. The remote controlled choke is considered necessary for well control not only for purposes of public health and safety, but also for conservation of the resources. For these reasons, the violation gravity has been retained as major.

C.4.a.ix. Several commenters suggested that requiring rotating heads for all exploratory wells is overly restrictive and that they should only be required when drilling in an underbalanced condition or where formation pressure cannot be reliably estimated. Exploratory drilling necessarily involves a high degree of uncertainty as to the pressures, conditions, or formations that may be encountered during drilling operations. Therefore, in the interest of public health and safety this requirement is considered necessary.

C.4.b.i. Two commenters urged that the requirement for maintaining a pH of 10 or greater in mud systems containing polymers be eliminated or an exception be granted for polymer muds. The commenters failed to be specific about the type of polymer system and polymer use. The term "polymer mud" includes many different types and chemically different polymer compounds. Since most polymers are mainly used for viscosity development, versus fluid loss control or shale stabilization, higher pH in many polymer systems yields maximum viscosity development. Individual mud system proposals contained in an Application for Permit to Drill (APD) are required to consider the necessity of higher mud pH when inhibiting H_2S returns to the surface and to weigh the expense of eliminating some mud additives not conducive in high pH mud environments to those that are. This minimum standard also contains a provision for the use of lesser pH muds if formation conditions or mud types justify it. The commenters also stated that corrosion control can be achieved by means other than increased pH. Another purpose of increasing pH is to prevent H_2S from reaching the surface by formation of sulfide radicals and increased scavenger efficiency. Therefore, the minimum standard for maintaining a mud pH of at least 10 is retained unless specifically approved in the APD or through a variance request.

It was suggested that the Order state that clear fluids may be used for workover and completion activities when such fluids are adequate for well control. The Order is silent on this point, and therefore such fluids may be used during those activities.

The first sentence has been reworded to clarify the BLM's intent to require a pH of 10 as a minimum standard, unless formation conditions dictate otherwise. In addition, the word "prevent" has been changed to "minimize" to more accurately describe the effects of pH with respect to H_2S.

C.4.b.iii. One commenter was confused by this requirement since it appeared to duplicate C.4.b.i. There is a significant differences between controlling the pH of the mud and the addition of scavengers and additives to the mud to control surface observed H_2S. It is because additional measures may be necessary when drilling unknown formations to control H_2S reaching the surface even if the 10 ph standard is met. The commenter also suggested that the violation gravity be changed from major to minor but provided no rationale. This suggestion was not adopted.

C.4.c. It was suggested that the word "suitable" in the first sentence be replaced with "designed per the requirements of API Recommended Practice—49 (RP–49)". This Order and RP–49 both utilize NACE standards. However, RP–49 utilizes additional standards not applicable to this requirement, therefore the more specific NACE standards have been referenced.

Several commenters suggested that the word "prevent" in the first sentence of the second paragraph be changed to "minimize" since these measures do not assure the prevention of stress corrosion cracking or embrittlement. The BLM agrees and the wording was changed.

Two commenters pointed out that NACE Standard MR–01–75 is not applicable in concentrations of less than 100 ppm of H_2S. The BLM recognizes this and it should be understood that the requirements of this Order do not apply unless 100 ppm or greater of H_2S is anticipated in the gas stream. However, this standard is deemed appropriate when the applicability criteria for this Order have been met.

It was suggested that the last sentence of the second paragraph be removed since obtaining the manufacturer's verification for H_2S service may be difficult for some existing equipment. The BLM does not see a reasonable alternative approach to determining suitability for H_2S service and considers it necessary for protecting public health and safety. Further, such verification would be difficult only in a very few cases, resulting in a negligible impact to industry overall. Therefore, the BLM considers this requirement to be reasonable and the suggestion was not adopted.

The fourth sentence of this requirement was modified to clarify that the current edition of the NACE standard is applicable.

C.4.d. Two commenters suggested that the paragraph be changed to allow for drill stem tests under certain conditions other than closed-chamber tests during daylight hours. The BLM recognizes that with proper planning and use of appropriate facilities, these tests can be conducted under other conditions. The existing language in the Order provides this latitude, and therefore no changes are necessary.

It was suggested that this paragraph be more specific to ensure that all gas is run through a separator and flared. The requirements of section III.C.4. are applicable to all operations, including testing, completions, and workovers. Therefore, no changes are necessary.

D.1.a. One commenter suggested that the words "that meet the criteria for requirement of H_2S controls but" be inserted between the words "facilities" and "which" to clarify what facilities is meant by the word "all". The initial criterion of 100 ppm H_2S in the gas stream for the applicability of this Order is sufficiently clear to determine the facilities included in this paragraph. Therefore, this suggestion was not adopted.

It was suggested that the timeframe for conformance be changed from 1 year to 6 months. Information submitted to the BLM indicates that it may take as long as 6 months to acquire some of the necessary equipment and since the commenter offered no rationale for the suggestion, the 1-year requirement is considered reasonable.

One commenter suggested that this paragraph make it clear to which equipment this requirement applies. The commenter is referred to the response provided under D.1.a. above.

D.2. It was recommended that the criteria for applicability be changed from 500 to 100 ppm H_2S for storage tank vapors. The commenter did not provide any rationale and the data submitted in response to proposed Order No. 2 in 1984 indicates that with the volumes of gas involved and using standard operating procedures, less than 500 ppm in this situation does not constitute a hazard to public health and safety.

D.2.d. Two commenters suggested that signs with colors of yellow and black should also be allowed under this requirement to be consistent with III.C.3.d.iii. The BLM believes that during production, H_2S hazards are known to be present. Therefore, danger signs (red, white and black) are appropriate rather than using caution signs (yellow and black) which are required during the drilling stage when H_2S may be, but is not necessarily known to be, present. Therefore, this suggestion was not adopted. One commenter suggested that it should be left to the operator's discretion as to the appropriate use of bilingual or multilingual signs. The authorized officers of the Bureau are very cognizant of those areas where such signs are appropriate, and therefore this suggestion was not adopted.

D.2.f. One commenter expressed that flexibility should be provided for those areas where the population adjacent to the H_2S operations is sparse and primarily consists of businesses associated with the oil and gas industry. This provision is intended to protect the general public, and if a situation as described occurs, a variance with appropriate alternate measures could be approved by the authorized officer.

Two commenters suggested that the words "other equivalent means" be added to this paragraph and section III.D.3.c. to provide more flexibility to the operator. This minimum requirement is considered reasonable when the specified criteria are met. The BLM recognizes that special cases will arise where alternative measures may be acceptable but has determined that a variance should be requested in such cases.

In reference to this paragraph and section III.D.3.c., one commenter expressed the view that the criteria of being within ¼ mile of an incorporated area may not be reasonable since some municipalities have incorporated large amounts of undeveloped land. The BLM recognizes this concern, but this would not be true for the majority of field situations. In situations where it does occur, the operator should request a variance.

Two commenters stated that the requirement to keep gates locked could endanger authorized personnel working at the site. The BLM agrees and has added Section III.D.2.g. to make it clear that the gates are to be locked when unattended by the operator. This section also specifies the degree of violation, corrective action, and the normal abatement period.

D.3.b. Several commenters questioned the reasonableness of requiring danger signs at all points where the well flowlines and lease gathering lines cross public or lease roads. They expressed concern that this requirement would cause an unnecessary cost and create potential visual degradation. They also stated that the placement of a sign at the entrance to each field or lease area would be adequate. It is the BLM's intent to identify sources where 100 ppm or more of H_2S in the gas stream may constitute a potential hazard. Therefore, the signing requirement is considered a reasonable measure to protect public health and safety. One of the same commenters also questioned the scope of this requirement. This requirement is applicable to all flowlines up to the approved measurement point.

D.3.d. For consistency with section III.D.2.g., the same requirement concerning locked gates has been established for production facilities under section III.D.3.d. Subsequent sections were redesignated accordingly.

D.3.e. (Redesignated D.3.f.) One commenter questioned what is meant by a "secondary means of immediate well control". The BLM intends this to mean that it is required to be on the stem of the christmas tree and that a wing valve would not meet this requirement. The same commenter recommended that this provision should only be applied to high volume/high pressure wells. All wells subject to the terms of this Order have the potential to create a hazardous environment, not just high volume/high pressure wells. Therefore, this suggestion was not adopted.

Two commenters also suggested that the requirement should be more flexible by specifically allowing the use of remotely operated valves triggered by a fixed ambient monitor. The existing wording provides the flexibility requested, and therefore this suggestion was not adopted.

It was recommended that the requirement for automatic shut-in equipment should be at the discretion of the authorized officer. However, the commenter did not offer any rationale for this suggestion. The BLM considers this requirement to be the appropriate minimum standard in order to promote conservation of the oil and gas resource, protect public health and safety, and prevent environment degradation. Therefore, this suggestion was not adopted.

One commenter suggested that existing wells be "grandfathered" and reviewed on a case-by-case basis with respect to the secondary means of well control specified in this section and the automatic safety valves or shutdowns specified in D.3.g. (Redesignated D.3.h.). Existing wells potentially constitute the majority of the hazards and to "grandfather" them does not meet one of the primary purposes of this Order, which is to protect public health and safety. Therefore, this suggestion was not adopted.

D.3.f. (Redesignated D.3.g.) It was recommended that all existing equipment that is in a safe working condition be specifically accepted as meeting the metallurgy standards, and that equipment which is not in a safe working condition be replaced. By safe the BLM means the equipment is operating as intended. The BLM agrees with this recommendation and has incorporated wording under section D.1.a. to exempt certain production equipment from metallurgical requirements. This exemption would not apply to new operational equipment, equipment that is unsafe, or repair and/or replacement parts.

D.3.g. (Redesignated D.3.h.) One commenter expressed that this requirement was ambiguously worded and suggested alternate wording. The BLM adopted the suggestion in part by adding "or other appropriate shut-in controls for wells equipped with

artificial lifts" at the end of the sentence.

It was noted that no requirement existed for utilizing the safety valves or shutdowns as required by this section. Therefore, a section requiring these controls to be activated upon a release of a potentially hazardous volume of H_2S was created and numbered as section III.D.3.i. in the final rule. All subsequent sections were redesignated accordingly.

D.3.h. (Redesignated as III.D.1.c.) The provisions of this section were intended to apply to both production facilities and storage tanks. Therefore, this section was moved and redesignated as section III.D.1.c. in the final rule. In addition, the wording was slightly modified to clarify the intent of this requirement.

Several commenters stated that the requirement for vapor recovery when the H_2S concentration reached 10 ppm or more at 50 feet from the facility was overly restrictive primarily because it does not constitute a hazard at that level, and the applicability criteria for the Order of 100 ppm in the gas stream was sufficiently restrictive. The 100 ppm concentration in the gas stream cannot be equated to the 10 ppm radius of exposure. A 10 ppm ambient concentration of H_2S implies a flow that could subject the public to a sustained level of H_2S. The 10 ppm level is the maximum acceptable for 8-hour working conditions, but is not acceptable for general public exposure. Further, such facilities are not fenced unless the criteria in D.2.f. or D.3.c. are met. Therefore, the requirement is considered reasonable in view of the concern for public health and safety.

It was suggested that the word "boundary" be added here to clarify the external limit of the facility. The term "production facility" has been adequately defined in the Order, and therefore the suggestion was not adopted.

D.3.i. (Redesignated (D.3.j.) Two commenters stated that although they supported the intent of this section, they felt the wording was awkward and questioned the authorized officer's qualifications to specify the design for modifying the facility. The BLM agrees that the wording is awkward. Further the intent was not to have the authorized officer specify the facility design. Therefore, the wording was changed for clarity and to indicate that the authorized officer will retain approval authority over, but not specify the design for modifying, the facility.

One commenter suggested that the phrase "or other areas where the public could reasonably be expected to frequent" needed to have limits placed on it. The BLM disagrees and this suggestion was not adopted.

It was suggested that this requirement be amended to make it clear that the limits do not apply in emergency or upset conditions. The BLM has partially adopted this suggestion by adding wording to show that it applies to sustained concentrations, but that modifications are subject to review by the authorized officer.

D.4. It was noted that no Violation, Corrective Action, or Normal Abatement Period existed for this requirement. These provisions were added in the final rule.

IV. Variances from Requirements

For consistency with Order No. 2, two commenters suggested that this Order specifically provide for verbal variances to be followed up by written requests. This Order, where appropriate, makes provisions for verbal variances, so that a general provision to that effect is not necessary here. It was also suggested that the Order require that variances be documented for the protection of the operator. This is provided for in the section which requires that variances "shall be submitted in writing" to the authorized officer.

Editorial and grammatical corrections and changes have been made as necessary.

The principal authors of this final rule are Chris Hanson of the Milwaukee District Office, Wisconsin; Hank Szymanski of the Washington, DC, Office; Bill Douglas of the Wyoming State Office, Ken Baker of the Great Falls Resource Area Office, Montana and Jim Rasmussen, formerly of the Elko District Office, Nevada, assisted by Al Riebau of the Wyoming State Office and the Orders Task Group, Mike Pool of the Division of Legislation and Regulatory Management, and the Office of the Solicitor, Department of the Interior.

It is hereby determined that this final rule does not constitute a major Federal action significantly affecting the quality of the human environment and that no detailed statement pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)) is required.

The Department of the Interior has determined that this document is not a major rule under Executive Order 12291 and will not have a significant economic impact on a substantial number of small entities under the Regulatory Flexibility Act (5 U.S.C. 601 et seq.).

The information collection requirements contained in this rulemaking have been approved by the Office of Management and Budget under 44 U.S.C. 3501 *et seq.* and are included in one of the following approvals: 1004–0134, 1004–0135 or 1004–0136.

List of Subjects in 43 CFR Part 3160

Government contracts, Mineral Royalties, Oil and gas exploration, Oil and gas production, Public lands-mineral resources, Indian lands-mineral resources, Reporting requirements.

Under the authorities stated below, part 3160, Group 3100, subchapter C, chapter II of title 43 of the Code of Federal Regulations is amended as set forth below:

Dated: October 12, 1990.

James M. Hughes,

Deputy Assistant Secretary of the Interior.

PART 3160—[AMENDED]

1. The authority citation for 43 CFR part 3160 continues to read:

§ 3164.1 [Amended]

2. Section 3154.1(b) is amended by revising the table which is part of § 3164.1(b):

* * * * *

(b) * * *

Order No.	Subject	Effective date	Federal Register reference	Supersedes
1.	Approval of operations	Nov. 21, 1983	48 FR 48918, and 48 FR 56226.	NTL-6
2.	Drilling operations	Dec. 19, 1988	53 FR 46798.	None.
3.	Site security	Mar. 27, 1989	54 FR 8060	NTL-7

Order No.	Subject	Effective date	FEDERAL REGISTER reference	Supersedes
.....	Measurement of oil	Aug. 23, 1989	54 FR 9066.	None.
5.	Measurement of Gas	March 27, 1989 for new facilities; August 23, 1989 for existing facilities measuring 200 MCF or more per day of gas; February 26, 1990 for existing facilities producing less than 200 MCF per day of gas..	54 FR 6100.	None.
6.	Hydrogen sulfide operations	January 22, 1991	55 FR ____	None.

Note: Numbers will be assigned by the Washington Office, Bureau of Land Management, to additional Orders as they are prepared for publication and added to this table.

Authority: The Mineral Leasing Act, as amended and supplemented (30 U.S.C. 181 et seq.); the Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351–359); the Act of May 31, 1930 (30 U.S.C. 301–306); the Act of March 3, 1909, as amended (25 U.S.C. 396); the Act of May 11, 1938, as amended (25 U.S.C. 396a–396g); the Act of February 28, 1891, as amended (25 U.S.C. 397); the Act of May 29, 1924 (25 U.S.C. 398); the Act of March 3, 1927 (25 U.S.C. 398a–398e); the Act of June 30, 1919, as amended (25 U.S.C. 399); R.S. 441 (43 U.S.C. 1457); Attorney General's Opinion of April 2, 1941 (40 Op.Atty.Gen. 41); the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 471 et seq.); the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4331 et seq.); the Act of December 12, 1980 (42 U.S.C. 6508); the Combined Hydrocarbon Leasing Act of 1981 (95 Stat. 1070); the Federal Oil and Gas Royalty Management Act of 1982 (30 U.S.C. 1701 et seq.); and the Indian Mineral Development Act of 1982 (25 U.S.C. 2102 et seq.).

Appendix—Text of Oil and Gas Order No. 6

Note: This appendix is published for information only and will not appear in the Code of Federal Regulations.

I. Introduction

A. Authority

This Order is established pursuant to the authority granted to the Secretary of the Interior through various Federal and Indian mineral leasing statutes and the Federal Oil and Gas Royalty Management Act of 1982. This authority has been delegated to the Bureau of Land Management and is implemented through the onshore oil and gas operating regulations contained in 43 CFR part 3160. More specifically, this Order implements and supplements the provisions of § 3162.1—General Requirements; § 3162.5–1(a)(c)(d)—Environmental Obligations; § 3162.5–2(a)—Control of Wells; and § 3162.5–3—Safety Precautions.

43 CFR 3164.1 specifically authorizes the Director, Bureau of Land Management, to issue Onshore Oil and Gas Orders, when necessary, to implement or supplement the operating regulations and provides that all such Orders shall be binding on the operator(s) of all Federal and Indian (except Osage Tribe) oil and gas leases which have been, or may hereafter be, issued. The authorized officer has the authority pursuant to 43 CFR 3161.2 to implement the provisions of this Order, require additional information, and approve any plans, applications, or variances required or allowed by the Order.

The authorized officer may, pursuant to 43 CFR 3164.2, issue Notices to Lessees and Operators (NTL's), after notice and comment, to supplement or provide variances of this Order as necessary to accommodate special conditions on a State or area-wide basis. Further information concerning variances may be found in section IV. of this Order.

B. Purpose

The purpose of this Order is to protect public health and safety and those personnel essential to maintaining control of the well. This Order identifies the Bureau of Land Management's uniform national requirements and minimum standards of performance expected from operators when conducting operations involving oil or gas that is known or could reasonably be expected to contain hydrogen sulfide (H_2S) or which results in the emission of sulfur dioxide (SO_2) as a result of flaring H_2S. This Order also identifies the gravity of violations, probable corrective action(s), and normal abatement periods.

C. Scope

This Order is applicable to all onshore Federal and Indian (except Osage Tribe) oil and gas leases when drilling, completing, testing, reworking, producing, injecting, gathering, storing, or treating operations are being conducted in zones which are known or could reasonably be expected to contain H_2S or which, when flared, could produce SO_2, in such concentrations that upon release they could constitute a hazard to human life. The requirements and minimum standards of this Order do not apply when operating in zones where H_2S is presently known not to be present or cannot reasonably be expected to be present in concentrations of 100 parts per million (ppm) or more in the gas stream.

The requirements and minimum standards in this Order do not relieve an operator from compliance with any applicable Federal, State, or local requirement(s) regarding H_2S or SO_2 which are more stringent.

II. Definitions

A. "Authorized officer" means any employee of the Bureau of Land Management authorized to perform the duties described in 43 CFR Groups 3000 and 3100 (3000.0–5).

B. *Christmas tree* means an assembly of valves and fittings used to control production and provide access to the producing tubing string. The assembly includes all equipment above the tubing-head top flange.

C. *Dispersion technique* means a mathematical representation of the physical and chemical transportation, dilution, and transformation of H_2S gas emitted into the atmosphere.

D. *Escape rate* means that the maximum volume (Q) used as the escape rate in determining the radius of exposure shall be that specified below, as applicable:

1. For a production facility, the escape rate shall be calculated using the maximum daily rate of gas produced through that facility or the best estimate thereof;

2. For gas wells, the escape rate shall be calculated by using the current daily

absolute open-flow rate against atmospheric pressure:

3. For oil wells, the escape rate shall be calculated by multiplying the producing gas/oil ratio by the maximum daily production rate or best estimate thereof;

4. For a well being drilled in a developed area, the escape rate may be determined by using the offset wells completed in the interval(s) in question.

E. *Essential personnel* means those on-site personnel directly associated with the operation being conducted and necessary to maintain control of the well.

F. *Exploratory well* means any well drilled beyond the known producing limits of a pool.

G. *Gas well* means a well for which the energy equivalent of the gas produced, including the entrained liquid hydrocarbons, exceeds the energy equivalent of the oil produced.

H. *H_2S Drilling Operations Plan* means a written plan which provides for safety of essential personnel and for maintaining control of the well with regard to H_2S and SO_2.

I. *Lessee* means a person or entity holding record title in a lease issued by the United States (3150.0–5).

J. *Major violation* means noncompliance which causes or threatens immediate, substantial, and adverse impacts on public health and safety, the environment, production accountability, or royalty income (3160.0–5).

K. *Minor violation* means noncompliance which does not rise to the level of a major violation (3160.0–5).

L. *Oil well* means a well for which the energy equivalent of the oil produced exceeds the energy equivalent of the gas produced, including the entrained liquid hydrocarbons.

M. *Operating rights owner* means a person or entity holding operating rights in a lease issued by the United States. A lessee may also be an operating rights owner if the operating rights in a lease or portion thereof have not been severed from record title (3160.0–5).

N. *Operator* means any person or entity including but not limited to the lessee or operating rights owner who has stated in writing to the authorized officer that he/she is responsible under the terms of the lease for the operations conducted on the leased lands or a portion thereof (3160.0–5).

O. *Potentially hazardous volume* means a volume of gas of such H_2S concentration and flow rate that it may result in radius of exposure-calculated ambient concentrations of 100 ppm H_2S at any occupied residence, school, church, park, school bus stop, place of business or other area where the public could reasonably to expected to frequent, or 500 ppm H_2S at any Federal, State, County or municipal road or highway.

P. *Production facilities* means any wellhead, flowline, piping, treating, or separating equipment, water disposal pits, processing plant or combination thereof prior to the approved measurement point for any lease, communitization agreement, or unit participating area.

Q. *Prompt correction* means immediate correction of violations, with operation suspended if required at the discretion of the authorized officer.

R. *Public Protection Plan* means a written plan which provides for the safety of the potentially affected public with regard to H_2S and SO_2.

S. *Radius of exposure* means the calculation resulting from using the following Pasquill-Gifford derived equation, or by such other method(s) as may be approved by the authorized officer:

1. For determining the 100 ppm radius of exposure where the H_2S concentration in the gas stream is less than 10 percent:

$$X = [1.589][(H_2S \text{ concentration})(Q)]^{(0.6258)}$$

or

2. For determining the 500 ppm radius of exposure where the H_2S concentration in the gas stream is less than 10 percent:

$$X = [(0.4546)(H_2S \text{ concentration})(Q)]^{(0.6258)}$$

where:

X = radius of exposure in feet;

H_2S Concentration = decimal equivalent of the mole or volume fractions (percent) of H_2S in the gaseous mixture;

Q = maximum volume of gas determined to be available for escape in cubic feet per day (at standard conditions of 14.73 psia and 60°F).

3. For determining the 100 ppm or the 500 ppm radius of exposure in gas streams containing H_2S concentrations of 10 percent or greater, a dispersion technique that takes into account representative wind speed, direction, atmospheric stability, complex terrain, other dispersion features shall be utilized. Such techniques may include, but shall not be limited to one of a series of computer models outlined in The Environmental Protection Agency's "Guidelines on Air Quality Models—(EPA–450/2–78–027R)."

4. Where multiple H_2S sources (i.e., wells, treatment equipment, flowlines, etc.) are present, the operator may elect to utilize a radius of exposure which covers a larger area than would be calculated using radius of exposure formula for each component part of the drilling/completion/workover/production system.

5. For a well being drilled in an area where insufficient data exists to calculate a radius of exposure, but where H_2S could reasonably be expected to be present in concentration in excess of 100 ppm in the gas stream, 100 ppm radius of exposure equal to 3,000 feet shall be assumed.

T. *Zones known to contain H_2S* means geological formations in a field where prior drilling, logging, coring, testing, or producing operations have confirmed that H_2S-bearing zones will be encountered that contain 100 ppm or more of H_2S in the gas stream.

U. *Zones known not to contain H_2S* means geological formations in a field where prior drilling, logging, coring, testing, or producing operations have confirmed the absence of H_2S-bearing zones that contain 100 ppm or more of H_2S in the gas stream.

V. *Zones which can reasonably be expected to contain H_2S* means geological formations in the area which have not had prior drilling, but prior drilling to the same formations in similar field(s) within the same geologic basin indicates there is a potential for 100 ppm or more of H_2S in the gas stream.

W. *Zones which cannot reasonably be expected to contain H_2S* means geological formations in the area which have not had prior drilling, but prior drilling to the same formations in similar field(s) within the same geologic basin indicates there is not a potential for 100 ppm or more of H_2S in the gas stream.

III. Requirements

The requirements of this Order are minimum acceptable standards with regard to H_2S operations. This Order also classifies violations as major or minor for purposes of the assessment and penalty provisions of 43 CFR part 3163, specifies the corrective action which will probably be required, and establishes the normal abatement period following detection of a major or minor violation in which the violator may take such corrective action without incurring an assessment. However, the authorized officer may, after consideration of all appropriate factors, require reasonable and necessary standards, corrective actions and abatement periods that may in some cases, vary from those specified in this Order that he/she determines to be necessary to protect public health and safety, the environment, or to maintain control of a well to prevent waste of Federal mineral resources. To the extent such standards, actions or abatement periods differ from those set forth in this Order, they may be subject to review pursuant to 43 CFR 3165.3.

A. *Applications, Approvals, and Reports*

Drilling

or proposed drilling operations where formations will be penetrated which have zones known to contain or which could reasonably be expected to contain concentrations of H_2S of 100 ppm or more in the gas stream. H_2S Drilling Operation Plan and if the applicability criteria in section III.B.1 are met, a Public Protection Plan as outlined in section III.B.2.b, shall be submitted as part of the Application for Permit to Drill (APD) (refer to Oil and Gas Order No. 1). In cases where multiple filings are being made with a single drilling plan, a single H_2S Drilling Operations Plan and, if applicable, a single Public Protection Plan may be submitted for the lease, communitization agreement, unit or field in accordance with Order No. 1. Failure to submit either the H_2S Drilling Operations Plan or the Public Protection Plan when required by this Order shall result in an incomplete APD pursuant to 43 CFR 3162.3–1.

The H_2S Drilling Operations Plan shall fully describe the manner in which the requirements and minimum standards in section III.C. shall be met and implemented. As required by this Order (section III.C.), the following must be mitted in the H_2S Drilling Operations n:

a. Statement that all personnel shall receive proper H_2S training in accordance with section III.C.3.a.

b. A legible well site diagram of accurate scale (may be included as part of the Well Site Layout as required by Onshore Order No. 1) showing the following:

i. Drill rig orientation

ii. Prevailing wind direction

iii. Terrain of surrounding area

iv. Location of all briefing areas (designate primary briefing area)

v. Location of access road(s) (including secondary egress)

vi. Location of flare line(s) and pit(s)

vii. Location of caution and/or danger signs

viii. Location of wind direction indicators

c. As required by this Order, a complete description of the following H_2S safety equipment/systems:

i. Well control equipment.

—Flare line(s) and means of ignition

—Remote controlled choke

—Flare gun/flares

—Mud-gas separator and rotating head (if exploratory well)

Protective equipment for essential sonnel.

—Location, type, storage and maintenance of all working and escape breathing apparatus

—Means of communication when using protective breathing apparatus

iii. H_2S detection and monitoring equipment.

—H_2S sensors and associated audible/visual alarm(s)

—Portable H_2S and SO_2 monitor(s)

iv. Visual warning systems.

—Wind direction indicators

—Caution/danger sign(s) and flag(s)

v. Mud program.

—Mud system and additives

—Mud degassing system

vi. Metallurgy.

—Metallurgical properties of all tubular goods and well control equipment which could be exposed to H_2S (section III.C.4.c.)

vii. Means of communication from wellsite.

d. Plans for well testing.

2. Production

a. For each existing production facility having an H_2S concentration of 100 ppm or more in the gas stream, the operator shall calculate and submit the calculations to the authorized officer within 180 days of the effective date of this Order, the 100 and, if applicable, the 500 ppm radii of exposure for all facilities to determine if the applicability criteria section III.B.1. of this order are met. Radii of exposure calculations shall not be required for oil or water flowlines. Further, if any of the applicability criteria (section III.B.1.) are met, the operator shall submit a complete Public Protection Plan which meets the requirements of section III.B.2.b. to the authorized officer within 1 year of the effective date of this Order. For production facilities constructed after the effective date of this Order and meeting the above minimum concentration (100 ppm in gas stream), the operator shall report the radii of exposure calculations, and if the applicability criteria (section III.B.1) are met, submit a complete Public Protection Plan (section III.B.2.b.) to the authorized officer within 60 days after completion of production facilities.

Violation: Minor for failure to submit required information.

Corrective Action: Submit required information (radii of exposure and/or complete Public Protection Plan).

Normal Abatement Period: 20 to 40 days.

b. The operator shall initially test the H_2S concentration of the gas stream for each well or production facility and shall make the results available to the authorized officer, upon request.

Violation: Minor.

Corrective Action: Test gas from well or production facility.

Normal Abatement Period: 20 to 40 days.

c. If operational or production alterations result in a 5% or more increase in the H_2S concentration (i.e., well recompletion, increased GOR's) or the radius of exposure as calculated under sections III.A.2.a. and III.A.2.b., notification of such changes shall be submitted to the authorized officer within 60 days after identification of the change.

Violation: Minor.

Corrective Action: Submit information to authorized officer.

Normal Abatement Period: 20 to 40 days.

3. Plans and Reports

a. H_2S Drilling Operations Plan(s) or Public Protection Plan(s) shall be reviewed by the operator on an annual basis and a copy of any necessary revisions shall be submitted to the authorized officer upon request.

Violation: Minor.

Corrective Action: Submit information to authorized officer.

Normal Abatement Period: 20 to 40 days.

b. Any release of a potentially hazardous volume of H_2S shall be reported to the authorized officer as soon as practicable, but no later than 24 hours following identification of the release.

Violation: Minor.

Corrective Action: Report undesirable event to the authorized officer.

Normal Abatement Period: 24 hours.

B. Public Protection

1. Applicability Criteria

For both drilling/completion/workover and production operations, the H_2S radius of exposure shall be determined on all wells and production facilities subject to this Order. A Public Protection Plan (Section III.B.2) shall be required when any of the following conditions apply:

a. The 100 ppm radius of exposure is greater than 50 feet and includes any occupied residence, school, church, park, school bus stop, place of business, or other areas where the public could reasonably be expected to frequent;

b. The 500 ppm radius of exposure is greater than 50 feet and includes any part of a Federal, State, County, or municipal road or highway owned and principally maintained for public use; or

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c. The 100 ppm radius of exposure is equal to or greater than 3,000 feet where facilities or roads are maintained for direct public access.

Additional specific requirements for drilling/completion/workover or producing operations are described in sections III.C. and III.D. of this Order, respectively.

2. Public Protection Plan

a. Plan Submission/Implementation/Availability—i. A Public Protection Plan providing details of actions to alert and protect the public in the event of a release of a potentially hazardous volume of H_2S shall be submitted to the authorized officer as required by Section III.A.1. for drilling or by section III.A.2.a. for producing operations when the applicability criteria established in section III.B.1. of this Order are met. One plan may be submitted for each well, lease, communitization agreement, unit, or field, at the operator's discretion. The Public Protection Plan shall be maintained and updated, in accordance with section III.A.3.a.

ii. The Public Protection Plan shall be activated immediately upon detection of release of a potentially hazardous volume of H_2S.

Violation: Major.

Corrective Action: Immediate implementation of the public protection plan.

Normal Abatement Period: Prompt correction required.

iii. A copy of the Public Protection Plan shall be available at the drilling/completion site for such wells and at the facility, field office, or with the pumper, as appropriate, for producing wells, facilities, and during workover operations.

Violation: Minor.

Corrective Action: Make copy of Plan available.

Normal Abatement Period: 24 hours (drilling/completion/workover), 5 to 7 days (production).

b. Plan Content. i. The details of the Public Protection Plan may vary according to the site specific characteristics (concentration, volume, terrain, etc.) expected to be encountered and the number and proximity of the population potentially at risk. In the areas of high population density or in other special cases, the authorized officer may require more stringent plans to be developed. These may include public education seminars, mass alert systems, and use of sirens, telephone, radio, and television depending on the number of people at risk and their location with respect to the well site.

ii. The Public Protection Plan shall include:

(a) The responsibilities and duties of key personnel, and instructions for alerting the public and requesting assistance;

(b) A list of names and telephone numbers of residents, those responsible for safety of public roadways, and individuals responsible for the safety of occupants of buildings within the 100 ppm radius of exposure (e.g. school principals, building managers, etc.) as defined by the applicability criteria in section III.B.1. The operator shall ensure that those who are at the greatest risk are notified first. The plan shall define when and how people are to be notified in case of an H_2S emergency.

(c) A telephone call list (including telephone numbers) for requesting assistance from law enforcement, fire department, and medical personnel and Federal and State regulatory agencies, as required. Necessary information to be communicated and the emergency responses that may be required shall be listed. This information shall be based on previous contacts with these organizations;

(d) A legible 100 ppm (or 3,000 feet, if conditions unknown) radius plat of all private and public dwellings, schools, roads, recreational areas, and other areas where the public might reasonably be expected to frequent;

(e) Advance briefings, by visit, meeting or letter to the people identified in section III.B.2.b.ii(b), including:

—Hazards of H_2S and SO_2;
—Necessity for an emergency action plan;
—Possible sources of H_2S and SO_2;
—Instructions for reporting a leak to the operator;
—The manner in which the public shall be notified of an emergency; and
—Steps to be taken in case of an emergency, including evacuation of any people;

(f) Guidelines for the ignition of the H_2S-bearing gas. The Plan shall designate the title or position of the person(s) who has the authority to ignite the escaping gas and define when, how, and by whom the gas is to be ignited;

(g) Additional measures necessary following the release of H_2S and SO_2 until the release is contained are as follows:

—Monitoring of H_2S and SO_2 levels and wind direction in the affected area;
—Maintenance of site security and access control;
—Communication of status of well control; and
—Other necessary measures as required by the authorized officer; and

(h) For production facilities, a description of the detection system(s) utilized to determine the concentration of H_2S released.

C. Drilling/Completion/Workover Requirements

1. General

a. A copy of the H_2S Drilling Operations Plan shall be available during operations at the well site beginning when the operation is subject to the terms of this Order (i.e., 3 days or 500 feet of known or probable H_2S zone).

Violation: Minor.

Corrective Action: Make copy of Plan available.

Normal Abatement Period: 24 hours.

b. Initial H_2S training shall be completed and all H_2S related safety equipment shall be installed, tested, and operational when drilling reaches a depth of 500 feet above, or 3 days prior to penetrating (whichever comes first) the first zone containing or reasonably expected to contain H_2S. A specific H_2S operations plan for completion and workover operations will not be required for approval. For completion and workover operations, all required equipment and warning systems shall be operational and training completed prior to commencing operations.

Violation: Major.

Corrective Action: Implement H_2S operational requirements, such as completion of training and/or installation, repair, or replacement of equipment, as necessary.

Normal Abatement Period: Prompt correction required.

c. If H_2S was not anticipated at the time the APD was approved, but is encountered in excess of 100 ppm in the gas stream, the following measures shall be taken:

(i) the operator shall immediately ensure control of the well, suspend drilling ahead operations (unless detrimental to well control), and obtain materials and safety equipment to bring the operations into compliance with the applicable provisions of this Order.

Violation: Major.

Corrective Action: Implement H_2S operational requirements, as applicable.

Normal Abatement Period: Prompt correction required.

ii. The operator shall notify the authorized officer of the event and the mitigating steps that have or are being taken as soon as possible, but no later than the next business day. If said notification is subsequent to actual resumption of drilling operations, the operator shall notify the authorized officer of the date that drilling was

resumed no later than the next business day.

Violation: Minor.

Corrective Action: Notify authorized officer.

Normal Abatement Period: 24 hours.

iii. It is the operator's responsibility to ensure that the applicable requirements of this Order have been met prior to the resumption of drilling ahead operations. Drilling ahead operations will not be suspended pending receipt of a written H_2S Drilling Operations Plan(s) and, if necessary, Public Protection Plan(s) provided that complete copies of the applicable Plan(s) are filed with the authorized officer for approval within 5 business days following resumption of drilling ahead operations.

Violation: Minor.

Corrective Action: Submit plans to authorization officer.

Normal Abatement Period: 5 days.

2. Locations.

a. Where practical, 2 roads shall be established, 1 at each end of the location, or as dictated by prevailing winds and terrain. If an alternate road is not practical, a clearly marked footpath shall be provided to a safe area. The purpose of such an alternate escape route is only to provide a means of egress to a safe area.

Violation: Minor.

Corrective Action: Designate or establish an alternate escape route.

Normal Abatement Period: 24 hours.

b. The alternate escape route shall be kept passable at all times.

Violation: Minor.

Corrective Action: Make alternate escape route passable.

Normal Abatement Period: 24 hours.

c. For workovers, a secondary means of egress shall be designated.

Violation: Minor.

Corrective Action: Designate secondary means of egress.

Normal Abatement Period: 24 hours.

3. Personnel Protection

a. Training Program. The operator shall ensure that all personnel who will be working at the wellsite will be properly trained in H_2S drilling and contingency procedures in accordance with the general training requirements outlined in the American Petroleum Institute's (API) *Recommended Practice (RP) 49 (April 15, 1987 or subsequent editions) for Safe Drilling of Wells Containing Hydrogen Sulfide, Section 2.* The operator also shall ensure that the training will be accomplished prior to a well coming under the terms of this Order (i.e., 3 days or 500 feet of known probable H_2S zone). In addition to the requirements of API-RP49, a minimum of an initial training session and weekly H_2S and well control drills for all personnel in each working crew shall be conducted. The initial training session for each well shall include a review of the site specific Drilling Operations Plan and, if applicable, the Public Protection Plan.

Violation: Major.

Corrective Action: Train all personnel and conduct drills.

Normal Abatement Period: Prompt correction required.

i. All training sessions and drills shall be recorded on the driller's log or its equivalent.

Violation: Minor.

Corrective Action: Record on driller's log or equivalent.

Normal Abatement Period: 24 hours.

ii. For drilling/completion/workover wells, at least 2 briefing areas shall be designated for assembly of personnel during emergency conditions, located a minimum of 150 feet from the well bore and 1 of the briefing areas shall be upwind of the well at all times. The briefing area located most normally upwind shall be designated as the "Primary Briefing Area."

Violation: Major.

Corrective Action: Designate briefing areas.

Normal Abatement Period: 24 hours.

iii. One person (by job title) shall be designated and identified to all on-site personnel as the person primarily responsible for the overall operation of the on-site safety and training programs.

Violation: Minor.

Corrective Action: Designate safety responsibilities.

Normal Abatement Period: 24 hours.

b. Protective Equipment: i. The operator shall ensure that proper respirator protection equipment program is implemented, in accordance with the current American National Standards Institute (ANSI) Standard Z.88.2-1980 *"Practices for Respiratory Protection."* Proper protective breathing apparatus shall be readily accessible to all essential personnel on a drilling/completion/workover site. Escape and pressure-demand type working equipment shall be provided for essential personnel in the H_2S environment to maintain or regain control of the well. For pressure-demand type working equipment those essential personnel shall be able to obtain a continuous seal to the face with the equipment. The operator shall ensure that service companies have the proper respiratory protection equipment when called to the location. Lightweight, escape-type, self-contained breathing apparatus with a minimum of 5-minute rated supply shall be readily accessible at a location for the derrickman and at any other location(s) where escape from an H_2S contaminated atmosphere would be difficult.

Violation: Major.

Corrective Action: Acquire, repair, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

ii. Storage and maintenance of protective breathing apparatus shall be planned to ensure that at least 1 working apparatus per person is readily available for all essential personnel.

Violation: Major.

Corrective Action: Acquire or rearrange equipment, as necessary.

Normal Abatement Period: Prompt correction required.

iii. The following additional safety equipment shall be available for use:

(a) Effective means of communication when using protective breathing apparatus;

(b) Flare gun and flares to ignite the well;

(c) Telephone, radio, mobile phone, or any other device that provides communication from a safe area at the rig location, where practical.

Violation: Major.

Corrective Action: Acquire, repair, or replace equipment.

Normal Abatement Period: 24 hours.

c. H_2S Detection and Monitoring Equipment. i. Each drilling/completion site shall have an H_2S detection and monitoring system that automatically activates visible and audible alarms when the ambient air concentration H_2S reaches the threshold limits of 10 and 15 ppm in air, respectively. The sensors shall have a rapid response time and be capable of sensing a minimum of 10 ppm of H_2S in ambient air, with at least 3 sensing points located at the shale shaker, rig floor, and bell nipple for a drilling site and the cellar, rig floor, and circulating tanks or shale shaker for a completion site. The detection system shall be installed, calibrated, tested, and maintained in accordance with the manufacturer's recommendations.

Violation: Major.

Corrective Action: Install, repair, calibrate, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

ii. All tests of the H_2S monitoring system shall be recorded on the driller's log or its equivalent.

Violation: Minor.

Corrective Action: Record on driller's log or equivalent.

Normal Abatement Period: 24 hours.

iii. For workover operations, 1 operational sensing point shall be

located as close to the wellbore as practical. Additional sensing points may be necessary for large and/or long-term operations.

Violation: Major.

Corrective Action: Install, repair, calibrate, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

d. Visible Warning System. i. Equipment to indicate wind direction at all times shall be installed at prominent locations and shall be visible at all times during drilling operations. At least 2 such wind direction indicators (i.e., windsocks, windvanes, pennants with tailstreamers, etc.) shall be located at separate elevations (i.e., near ground level, rig floor, and/or treetop height). At least 1 wind direction indicator shall be clearly visible from all principal working areas at all times so that wind direction can be easily determined. For completion/workover operations, 1 wind direction indicator shall suffice, provided it is visible from all principal working areas on the location. In addition, a wind direction indicator at each of the 2 briefing areas shall be provided if the wind direction indicator(s) previously required in this paragraph are not visible from the briefing areas.

Violation: Minor.

Corrective Action: Install, repair, move, or replace wind direction indicator(s), as necessary.

Normal Abatement Period: 24 hours.

ii. At any time when the terms of this Order are in effect, operational danger or caution sign(s) shall be displayed along all controlled accesses to the site.

Violation: Minor.

Corrective Action: Erect appropriate signs.

Normal Abatement Period: 24 hours.

iii. Each sign shall be painted a high-visibility red, black and white, or yellow with black lettering.

Violation: Minor.

Corrective Action: Replace or alter sign, as necessary.

Normal Abatement Period: 5 to 20 days.

iv. The sign(s) shall be legible and large enough to be read by all persons entering the well site and be placed a minimum of 200 feet but no more than 500 feet from the well site which allows vehicles to turn around at a safe distance prior to reaching the site.

Violation: Major.

Corrective Action: Replace, alter, or move sign, as necessary.

Normal Abatement Period: 24 hours.

v. The sign(s) shall read:

DANGER—POISON GAS—
HYDROGEN SULFIDE

and in smaller lettering:

Do Not Approach If Red Flag is Flying

or equivalent language if approved by the authorized officer.

Where appropriate, bilingual or multilingual danger sign(s) shall be used.

Violation: Minor.

Corrective Action: Alter sign(s) as necessary.

Normal Abatement Period: 5 to 20 days.

vi. All sign(s) and, when appropriate, flag(s) shall be visible to all personnel approaching the location under normal lighting and weather conditions.

Violation: Major.

Corrective Action: Erect or move sign(s) and/or flag(s), as necessary.

Normal Abatement Period: 24 hours.

vii. When H_2S is detected in excess of 10 ppm at any detection point, red flag(s) shall be displayed.

Violation: Major.

Corrective Action: Display red flag.

Normal Abatement Period: Prompt correction required.

e. Warning System Response. When H_2S is detected in excess of 10 ppm at any detection point, all non-essential personnel shall be moved to a safe area and essential personnel (i.e., those necessary to maintain control of the well) shall wear pressure-demand type protective breathing apparatus. Once accomplished, operations may proceed.

Violation: Major.

Corrective Action: Move non-essential personnel to safe area and mask-up essential personnel.

Normal Abatement Period: Prompt correction required.

4. Operating Procedures and Equipment

a. *General/Operations.* Drilling/completion/workover operations in H_2S areas shall be subject to the following requirements:

i. If zones containing in excess of 100 ppm of H_2S gas are encountered while drilling with air, gas, mist, other non-mud circulating mediums or aerated mud, the well shall be killed with a water or oil-based mud and mud shall be used thereafter as the circulating medium for continued drilling.

Violation: Major.

Corrective Action: Convert to appropriate fluid medium.

Normal Abatement Period: Prompt correction required.

ii. A flare system shall be designed and installed to safely gather and burn H_2S-bearing gas.

Violation: Major.

Corrective Action: Install flare system.

Normal Abatement Period: Prompt correction required.

iii. Flare lines shall be located as far from the operating site as feasible and in a manner to compensate for wind changes. The flare line(s) mouth(s) shall be located not less than 150 feet from the wellbore unless otherwise approved by the authorized officer. Flare lines shall be straight unless targeted with running tees.

Violation: Minor.

Corrective Action: Adjust flare line(s) as necessary.

Normal Abatement Period: 24 hours.

iv. The flare system shall be equipped with a suitable and safe means of ignition.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 24 hours.

v. Where noncombustible gas is to be flared, the system shall be provided supplemental fuel to maintain ignition.

Violation: Major.

Corrective Action: Acquire supplemental fuel.

Normal Abatement Period: 24 hours.

vi. At any wellsite where SO_2 may be released as a result of flaring of H_2S during drilling, completion, or workover operations, the operator shall make SO_2 portable detection equipment available for checking the SO_2 level in the flare impact area.

Violation: Minor.

Corrective Action: Acquire, repair, or replace equipment as necessary.

Normal Abatement Period: 24 hours to 3 days.

vii. If the flare impact area reaches a sustained ambient threshold level of 2 ppm or greater of SO_2 in air and includes any occupied residence, school, church, park, or place of business, or other area where the public could reasonably be expected to frequent, the Public Protection Plan shall be implemented.

Violation: Major.

Corrective Action: Contain SO_2 release and/or implement Public Protection Plan.

Normal Abatement Period: Prompt correction required.

viii. A remote controlled choke shall be installed for all H_2S drilling and, where feasible, for completion operations. A remote controlled valve may be used in lieu of this requirement for completion operations.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

ix. Mud-gas separators and rotating heads shall be installed and operable for exploratory wells.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

b. Mud Program. i. A pH of 10 or above in a fresh water-base mud system shall be maintained to control corrosion, H_2S gas returns to surface, and minimize sulfide stress cracking and embrittlement unless other formation conditions or mud types justify a lesser pH level.

Violation: Major.

Corrective Action: Adjust pH.

Normal Abatement Period: Prompt correction required.

ii. Drilling mud containing H_2S gas shall be degassed in accordance with API's RP-49, § 5.14, at an optimum location for the rig configuration. These gases shall be piped into the flare system.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 24 hours.

iii. Sufficient quantities of mud additives shall be maintained on location to scavenge and/or neutralize H_2S where formation pressures are unknown.

Violation: Major.

Corrective Action: Obtain proper mud additives.

Normal Abatement Period: 24 hours.

c. *Metallurgical Equipment.* All equipment that has the potential to be exposed to H_2S shall be suitable for H_2S service. Equipment which shall meet these metallurgical standards include the drill string, casing, wellhead, blowout preventer assembly, casing head and spool, rotating head, kill lines, choke, choke manifold and lines, valves, mud-gas separators, drill-stem test tools, test units, tubing, flanges, and other related equipment.

To minimize stress corrosion cracking and/or H_2S embrittlement, the equipment shall be constructed of material whose metallurgical properties are chosen with consideration for both an H_2S working environment and the anticipated stress. The metallurgical properties of the materials used shall conform to the current National Association of Corrosion Engineers (NACE) Standard MR-01-75, *Material Requirement, Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment.* These metallurgical properties include the grade of steel, the processing method (rolled, normalized, tempered, and/or quenched), and the resulting strength properties. The working environment considerations include the H_2S concentration, the well fluid pH, and the wellbore pressures and temperatures. Elastomers, packing, and similar inner parts exposed to H_2S shall be resistant at the maximum anticipated temperature of exposure. The manufacturer's verification of design for use in an H_2S environment shall be sufficient verification of suitable service in accordance with this Order.

Violation: Major.

Corrective Action: Install, repair, or replace appropriate equipment, as necessary.

Normal Abatement Period: Prompt correction required.

d. Well Testing in an H_2S Environment. Testing shall be performed with a minimum number of personnel in the immediate vicinity which are necessary to safely and adequately operate the test equipment. Except with prior approval by the authorized officer, the drill-stem testing of H_2S zones shall be conducted only during daylight hours and formation fluids shall not be flowed to the surface (closed chamber only).

Violation: Major

Corrective Action: Terminate the well test.

Normal Abatement Period: Prompt correction required.

D. Production Requirements

1. General

a. All existing production facilities which do not currently meet the requirements and minimum standards set forth in this section shall be brought into conformance within 1 year after the effective date of this Order. All existing equipment that is in a safe working condition as of the effective date of this Order is specifically exempt from the metallurgical requirements prescribed in section III D.3.g.

Violation: Minor.

Corrective Action: Bring facility into compliance.

Normal Abatement Period: 60 days.

b. Production facilities constructed after the effective date of this Order shall be designed, constructed, and operated to meet the requirements and minimum standards set forth in this section. Any variations from the standards or established time frames shall be approved by the authorized officer in accordance with the provisions of section IV, of this Order. Except for storage tanks, a determination of the radius of exposure for all production facilities shall be made in the manner prescribed in section II. S. of this Order.

Violation: Minor.

Corrective Action: Bring facility into compliance.

Normal Abatement Period: 60 days.

c. At any production facility or storage tank(s) where the sustained ambient H_2S concentration is in excess of 10 ppm at 50 feet from the production facility or storage tank(s) as measured at ground level under calm (1 mph) conditions, the operator shall collect or reduce vapors from the system and they shall be sold, beneficially used, reinjected, or flared provided terrain and conditions permit.

Violation: Major, if a health or safety problem to the public is imminent, otherwise minor.

Corrective Action: Bring facility into compliance.

Normal Abatement Period: 3 days for major, 30 days for minor.

2. Storage Tanks.

Storage tanks containing produced fluids and utilized as part of a production operation and operated at or near atmospheric pressure, where the vapor accumulation has an H_2S concentration in excess of 500 ppm in the tank, shall be subject to the following:

a. No determination of a radius of exposure need be made for storage tanks.

b. All stairs/ladders leading to the top of storage tanks shall be chained and/or marked to restrict entry. For any storage tank(s) which require fencing (Section III.D.2.f), a danger sign posted at the gate(s) shall suffice in lieu of this requirement.

Violation: Minor.

Corrective Action: Chain or mark stair(s)/ladder(s) or post sign, as necessary.

Normal Abatement Period: 5 to 20 days.

c. A danger sign shall be posted on or within 50 feet of the storage tank(s) to alert the public of the potential H_2S danger. For any storage tank(s) which require fencing (section III.D.2.f.), a danger sign posted at the locked gate(s) shall suffice in lieu of this requirement.

Violation: Minor.

Corrective Action: Post or move sign(s), as necessary.

Normal Abatement Period: 5 to 20 days.

d. The sign(s) shall be painted in high-visibility red, black, and white. The sign(s) shall read:

DANGER—POISON GAS-HYDROGEN SULFIDE

or equivalent language if approved by the authorized officer. Where

appropriate, bilingual or multilingual warning signs shall be used.

Violation: Minor.

Corrective Action: Post, move, replace, or alter sign(s), as necessary.

Normal Abatement Period: 20 to 40 days.

e. At least 1 permanent wind direction indicator shall be installed so that wind direction can be easily determined at or approaching the storage tank(s).

Violation: Minor.

Corrective Action: Install, repair, or replace wind direction indicator, as necessary.

Normal Abatement Period: 20 to 40 days.

f. A minimum 5-foot chain-link, 5-strand barbed wire, or comparable type fence and gate(s) that restrict(s) public access shall be required when storage tanks are located within ¼ mile of or contained inside a city or incorporated limits of a town or within ¼ mile of an occupied residence, school, church, park, playground, school bus stop, place of business, or where the public could reasonably he expected to frequent.

Violation: Minor.

Corrective Action: Install, repair, or replace fence and/or gate(s), as necessary.

Normal Abatement Period: 20 to 40 days.

g. Gate(s), as required by section III.D.2.f. shall be locked when unattended by the operator.

Violation: Minor.

Corrective Action: Lock gate.

Normal Abatement Period: 24 hours.

3. Production Facilities

Production facilities containing 100 ppm or more of H_2S in the gas stream shall be subject to the following:

a. Danger signs as specified in section III.D.2.d. of this Order shall be posted on or within 50 feet of each production facility to alert the public of the potential H_2S danger. In the event the storage tanks and production facilities are located at the same site, 1 such danger sign shall suffice. Further, for any facilities which require fencing (section III.D.2.f.), 1 such danger sign at the gate(s) shall suffice in lieu of this requirement.

Violation: Minor.

Corrective Action: Post, move, or alter sign(s), as necessary.

Normal Abatement Period: 5 to 20 days.

b. Danger signs, as specified in section III.D.2.d. of this Order, shall be required for well flowlines and lease gathering lines that carry H_2S gas. Placement shall be where said lines cross public or lease roads. The signs shall be legible and shall contain sufficient additional information to permit a determination of the owner of the line.

Violation: Minor.

Corrective Action: Post, move, or alter sign(s), as necessary.

Normal Abatement Period: 5 to 20 days.

c. Fencing, as specified in section III.D.2.f., shall be required when production facilities are located within ¼ mile of or contained inside a city or incorporated limits of a town or within ¼ mile of an occupied residence, school, church, park, playground, school bus stop, place of business, or any other area where the public could reasonably be expected to frequent. Flowlines are exempted from this additional fencing requirement.

Violation: Minor.

Corrective Action: Install, repair, or replace fence, and/or gate(s), as necessary.

Normal Abatement Period: 20 to 40 days.

d. Gate(s), as required by section III.D.3.c. shall be locked when unattended by the operator.

Violation: Minor.

Corrective Action: Lock gate.

Normal Abatement Period: 24 hours.

e. Wind direction indicator(s) as specified in section III.D.2.e. of this Order shall be required. In the event the storage tanks and production facilities are located at the same site, 1 such indicator shall suffice. Flowlines are exempt from this requirement.

Violation: Minor.

Corrective Action: Install, repair, or replace wind direction indicator(s), as necessary.

Normal Abatement Period: 20 to 40 days.

f. All wells, unless produced by artificial lift, shall possess a secondary means of immediate well control through the use of appropriate christmas tree and/or downhole completion equipment. Such equipment shall allow downhole accessibility (reentry) under pressure for permanent well control operations. If the applicability criteria stated in Section III.B.1. of this Order are met, a minimum of 2 master valves shall be installed.

Violation: Minor.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 20 to 40 days.

g. All equipment shall be chosen with consideration for both a H_2S working environment and anticipated stresses. NACE Standard MR-01-75 shall be used for metallic equipment selection and, if applicable, adequate protection by chemical inhibition or other such method that controls or limits the corrosive effects of H_2S shall be used.

Violation: Minor.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 20 to 40 days.

h. Where the 100 ppm radius of exposure for H_2S includes any occupied residence, place of business, school, or other inhabited structure or any area where the public may reasonably be expected to frequent, the operator shall install automatic safety valves or shutdowns at the wellhead, or other appropriate shut-in controls for wells equipped with artificial lift.

Violation: Minor.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 20 to 40 days.

i. The automatic safety valves or shutdowns, as required by section III.D.3.h. shall be set to activate upon a release of a potentially hazardous volume of H_2S.

Violation: Major.

Corrective Action: Repair, replace or adjust equipment, as necessary.

Normal Abatement Period: Prompt correction required.

j. If the sustained ambient concentration of H_2S or SO_2 from a production facility which is venting or flaring reaches a concentration of H_2S (10ppm) or SO_2 (2ppm), respectively, at any of the following locations, the operator shall modify the production facility as approved by the authorized officer. The locations include any occupied residence, school, church, park, playground, school bus stop, place of business, or other areas where the public could reasonably be expected to frequent.

Violation: Major.

Corrective Action: Repair facility to bring into compliance.

Normal Abatement Period: Prompt correction required.

4. Public Protection.

When conditions as defined in section III.B.1. of this Order exist, a Public Protection Plan for producing operations shall be submitted to the authorized officer in accordance with section III.B.2.a. of this Order which includes the provisions of section III.B.2.b.

Violation: Minor.

Corrective Action: Submit Public Protection Plan.

Normal Abatement Period: 20 to 40 days.

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IV. Variances from Requirements

An operator may request the authorized officer to approve a variance from any of the requirements prescribed in Section III hereof. All such requests shall be submitted in writing to the appropriate authorized officer and provide information as to the circumstances which warrant approval of the variance(s) requested and the proposed alternative methods by which the related requirement(s) of minimum standard(s) are to be satisfied. The authorized officer, after considering all relevant factors, may approve the requested variance(s) if it is determined that the proposed alternative(s) meets or exceeds the objectives of the applicable requirement(s) or minimum standard(s).

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artificial lifts" at the end of the sentence.

It was noted that no requirement existed for utilizing the safety valves or shutdowns as required by this section. Therefore, a section requiring these controls to be activated upon a release of a potentially hazardous volume of H_2S was created and numbered as section III.D.3.i. in the final rule. All subsequent sections were redesignated accordingly.

D.3.h. (Redesignated as III.D.1.c.) The provisions of this section were intended to apply to both production facilities and storage tanks. Therefore, this section was moved and redesignated as section III.D.1.c. in the final rule. In addition, the wording was slightly modified to clarify the intent of this requirement.

Several commenters stated that the requirement for vapor recovery when the H_2S concentration reached 10 ppm or more at 50 feet from the facility was overly restrictive primarily because it does not constitute a hazard at that level, and the applicability criteria for the Order of 100 ppm in the gas stream was sufficiently restrictive. The 100 ppm concentration in the gas stream cannot be equated to the 10 ppm radius of exposure. A 10 ppm ambient concentration of H_2S implies a flow that could subject the public to a sustained level of H_2S. The 10 ppm level is the maximum acceptable for 8-hour working conditions, but is not acceptable for general public exposure. Further, such facilities are not fenced unless the criteria in D.2.f. or D.3.c. are met. Therefore, the requirement is considered reasonable in view of the concern for public health and safety.

It was suggested that the word "boundary" be added here to clarify the external limit of the facility. The term "production facility" has been adequately defined in the Order, and therefore the suggestion was not adopted.

D.3.i. (Redesignated (D.3.j.) Two commenters stated that although they supported the intent of this section, they felt the wording was awkward and questioned the authorized officer's qualifications to specify the design for modifying the facility. The BLM agrees that the wording is awkward. Further the intent was not to have the authorized officer specify the facility design. Therefore, the wording was changed for clarity and to indicate that the authorized officer will retain approval authority over, but not specify the design for modifying, the facility.

One commenter suggested that the phrase "or other areas where the public could reasonably be expected to frequent" needed to have limits placed on it. The BLM disagrees and this suggestion was not adopted.

It was suggested that this requirement be amended to make it clear that the limits do not apply in emergency or upset conditions. The BLM has partially adopted this suggestion by adding wording to show that it applies to sustained concentrations, but that modifications are subject to review by the authorized officer.

D.4. It was noted that no Violation, Corrective Action, or Normal Abatement Period existed for this requirement. These provisions were added in the final rule.

IV. Variances from Requirements

For consistency with Order No. 2, two commenters suggested that this Order specifically provide for verbal variances to be followed up by written requests. This Order, where appropriate, makes provisions for verbal variances, so that a general provision to that effect is not necessary here. It was also suggested that the Order require that variances be documented for the protection of the operator. This is provided for in the section which requires that variances "shall be submitted in writing" to the authorized officer.

Editorial and grammatical corrections and changes have been made as necessary.

The principal authors of this final rule are Chris Hanson of the Milwaukee District Office, Wisconsin; Hank Szymanski of the Washington, DC, Office; Bill Douglas of the Wyoming State Office, Ken Baker of the Great Falls Resource Area Office, Montana and Jim Rasmussen, formerly of the Elko District Office, Nevada, assisted by Al Riebau of the Wyoming State Office and the Orders Task Group, Mike Pool of the Division of Legislation and Regulatory Management, and the Office of the Solicitor, Department of the Interior.

It is hereby determined that this final rule does not constitute a major Federal action significantly affecting the quality of the human environment and that no detailed statement pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)) is required.

The Department of the Interior has determined that this document is not a major rule under Executive Order 12291 and will not have a significant economic impact on a substantial number of small entities under the Regulatory Flexibility Act (5 U.S.C. 601 et seq.).

The information collection requirements contained in this rulemaking have been approved by the Office of Management and Budget under 44 U.S.C. 3501 *et seq.* and are included in one of the following approvals: 1004–0134, 1004–0135 or 1004–0136.

List of Subjects in 43 CFR Part 3160

Government contracts, Mineral Royalties, Oil and gas exploration, Oil and gas production, Public lands-mineral resources, Indian lands-mineral resources, Reporting requirements.

Under the authorities stated below, part 3160, Group 3100, subchapter C, chapter II of title 43 of the Code of Federal Regulations is amended as set forth below:

Dated: October 12, 1990.

James M. Hughes,

Deputy Assistant Secretary of the Interior.

PART 3160—[AMENDED]

1. The authority citation for 43 CFR part 3160 continues to read:

§ 3164.1 [Amended]

2. Section 3164.1(b) is amended by revising the table which is part of § 3164.1(b):

* * * * *

(b) * * *

Order No.	Subject	Effective date	Federal Register reference	Supersedes
1.	Approval of operations	Nov. 21, 1983	48 FR 48916, and 48 FR 56226.	NTL-6
2.	Drilling operations	Dec. 19, 1988	53 FR 46798.	None.
3.	Site security	Mar. 27, 1989	54 FR 8060	NTL-7

Order No.	Subject	Effective date	Federal Register reference	Supersedes
.....	Measurement of oil.	Aug. 23, 1989	54 FR 6086.	None.
5.	Measurement of Gas.	March 27, 1989 for new facilities; August 23, 1989 for existing facilities measuring 200 MCF or more per day of gas; February 26, 1990 for existing facilities producing less than 200 MCF per day of gas..	54 FR 6100.	None.
6.	Hydrogen sulfide operations	January 22, 1991	56 FR	None.

Note: Numbers will be assigned by the Washington Office, Bureau of Land Management, to additional Orders as they are prepared for publication and added to this table.

Authority: The Mineral Leasing Act, as amended and supplemented (30 U.S.C. 181 et seq.); the Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351–359); the Act of May 31, 1930 (30 U.S.C. 301–306); the Act of March 3, 1909, as amended (25 U.S.C. 396); the Act of May 11, 1938, as amended (25 U.S.C. 396a–396g); the Act of February 28, 1891, as amended (25 U.S.C. 397); the Act of May 29, 1924 (25 U.S.C. 398); the Act of March 3, 1927 (25 U.S.C. 398a–398e); the Act of June 30, 1919, as amended (25 U.S.C. 399); R.S. 441 (43 U.S.C. 1457); Attorney General's Opinion of April 2, 1941 (40 Op.Atty.Gen. 41); the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 471 et seq.); the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4331 et seq.); the Act of December 12, 1980 (42 U.S.C. 6508); the Combined Hydrocarbon Leasing Act of 1981 (95 Stat. 1070); the Federal Oil and Gas Royalty Management Act of 1982 (30 U.S.C. 1701 et seq.); and the Indian Mineral Development Act of 1982 (25 U.S.C. 2102 et seq.).

Appendix—Text of Oil and Gas Order No. 6

Note: This appendix is published for information only and will not appear in the Code of Federal Regulations.

I. Introduction

A. Authority

This Order is established pursuant to the authority granted to the Secretary of the Interior through various Federal and Indian mineral leasing statutes and the Federal Oil and Gas Royalty Management Act of 1982. This authority has been delegated to the Bureau of Land Management and is implemented through the onshore oil and gas operating regulations contained in 43 CFR part 3160. More specifically, this Order implements and supplements the provisions of § 3162.1—General Requirements; § 3162.5–1(a)(c)(d)—Environmental Obligations; § 3162.5–2(a)—Control of Wells; and § 3162.5–3—Safety Precautions.

43 CFR 3164.1 specifically authorizes the Director, Bureau of Land Management, to issue Onshore Oil and Gas Orders, when necessary, to implement or supplement the operating regulations and provides that all such Orders shall be binding on the operator(s) of all Federal and Indian (except Osage Tribe) oil and gas leases which have been, or may hereafter be, issued. The authorized officer has the authority pursuant to 43 CFR 3161.2 to implement the provisions of this Order, require additional information, and approve any plans, applications, or variances required or allowed by the Order.

The authorized officer may, pursuant to 43 CFR 3164.2, issue Notices to Lessees and Operators (NTL's), after notice and comment, to supplement or provide variances of this Order as necessary to accommodate special conditions on a State or area-wide basis. Further information concerning variances may be found in section IV. of this Order.

B. Purpose

The purpose of this Order is to protect public health and safety and those personnel essential to maintaining control of the well. This Order identifies the Bureau of Land Management's uniform national requirements and minimum standards of performance expected from operators when conducting operations involving oil or gas that is known or could reasonably be expected to contain hydrogen sulfide (H_2S) or which results in the emission of sulfur dioxide (SO_2) as a result of flaring H_2S. This Order also identifies the gravity of violations, probable corrective action(s), and normal abatement periods.

C. Scope

This Order is applicable to all onshore Federal and Indian (except Osage Tribe) oil and gas leases when drilling, completing, testing, reworking, producing, injecting, gathering, storing, or treating operations are being conducted in zones which are known or could reasonably be expected to contain H_2S or which, when flared, could produce SO_2, in such concentrations that upon release they could constitute a hazard to human life. The requirements and minimum standards of this Order do not apply when operating in zones where H_2S is presently known not to be present or cannot reasonably be expected to be present in concentrations of 100 parts per million (ppm) or more in the gas stream.

The requirements and minimum standards in this Order do not relieve an operator from compliance with any applicable Federal, State, or local requirement(s) regarding H_2S or SO_2 which are more stringent.

II. Definitions

A. "Authorized officer" means any employee of the Bureau of Land Management authorized to perform the duties described in 43 CFR Groups 3000 and 3100 (3000.0–5).

B. *Christmas tree* means an assembly of valves and fittings used to control production and provide access to the producing tubing string. The assembly includes all equipment above the tubing-head top flange.

C. *Dispersion technique* means a mathematical representation of the physical and chemical transportation, dilution, and transformation of H_2S gas emitted into the atmosphere.

D. *Escape rate* means that the maximum volume (Q) used as the escape rate in determining the radius of exposure shall be that specified below, as applicable:

1. For a production facility, the escape rate shall be calculated using the maximum daily rate of gas produced through that facility or the best estimate thereof;

2. For gas wells, the escape rate shall be calculated by using the current daily

absolute open-flow rate against atmospheric pressure:

3. For oil wells, the escape rate shall be calculated by multiplying the producing gas/oil ratio by the maximum daily production rate or best estimate thereof;

4. For a well being drilled in a developed area, the escape rate may be determined by using the offset wells completed in the interval(s) in question.

E. *Essential personnel* means those on-site personnel directly associated with the operation being conducted and necessary to maintain control of the well.

F. *Exploratory well* means any well drilled beyond the known producing limits of a pool.

G. *Gas well* means a well for which the energy equivalent of the gas produced, including the entrained liquid hydrocarbons, exceeds the energy equivalent of the oil produced.

H. *H_2S Drilling Operations Plan* means a written plan which provides for safety of essential personnel and for maintaining control of the well with regard to H_2S and SO_2.

I. *Lessee* means a person or entity holding record title in a lease issued by the United States (3160.0–5).

J. *Major violation* means noncompliance which causes or threatens immediate, substantial, and adverse impacts on public health and safety, the environment, production accountability, or royalty income (3160.0–5).

K. *Minor violation* means noncompliance which does not rise to the level of a major violation (3160.0–5).

L. *Oil well* means a well for which the energy equivalent of the oil produced exceeds the energy equivalent of the gas produced, including the entrained liquid hydrocarbons.

M. *Operating rights owner* means a person or entity holding operating rights in a lease issued by the United States. A lessee may also be an operating rights owner if the operating rights in a lease or portion thereof have not been severed from record title (3160.0–5).

N. *Operator* means any person or entity including but not limited to the lessee or operating rights owner who has stated in writing to the authorized officer that he/she is responsible under the terms of the lease for the operations conducted on the leased lands or a portion thereof (3160.0–5).

O. *Potentially hazardous volume* means a volume of gas of such H_2S concentration and flow rate that it may result in radius of exposure-calculated ambient concentrations of 100 ppm H_2S at any occupied residence, school, church, park, school bus stop, place of business or other area where the public could reasonably to expected to frequent, or 500 ppm H_2S at any Federal, State, County or municipal road or highway.

P. *Production facilities* means any wellhead, flowline, piping, treating, or separating equipment, water disposal pits, processing plant or combination thereof prior to the approved measurement point for any lease, communitization agreement, or unit participating area.

Q. *Prompt correction* means immediate correction of violations, with operation suspended if required at the discretion of the authorized officer.

R. *Public Protection Plan* means a written plan which provides for the safety of the potentially affected public with regard to H_2S and SO_2.

S. *Radius of exposure* means the calculation resulting from using the following Pasquill-Gifford derived equation, or by such other method(s) as may be approved by the authorized officer:

1. For determining the 100 ppm radius of exposure where the H_2S concentration in the gas stream is less than 10 percent:

$$X = [1.589](H_2S \text{ concentration})(Q)]^{(0.625)}$$

or

2. For determining the 500 ppm radius of exposure where the H_2S concentration in the gas stream is less than 10 percent:

$$X = [(0.4546)(H_2S \text{ concentration})(Q)]^{(0.625)}$$

where:

X = radius of exposure in feet;

H_2S Concentration = decimal equivalent of the mole or volume fractions (percent) of H_2S in the gaseous mixture;

Q = maximum volume of gas determined to be available for escape in cubic feet per day (at standard conditions of 14.73 psia and 60°F).

3. For determining the 100 ppm or the 500 ppm radius of exposure in gas streams containing H_2S concentrations of 10 percent or greater, a dispersion technique that takes into account representative wind speed, direction, atmospheric stability, complex terrain, other dispersion features shall be utilized. Such techniques may include, but shall not be limited to one of a series of computer models outlined in The Environmental Protection Agency's "Guidelines on Air Quality Models—(EPA–450/2–78–027R)."

4. Where multiple H_2S sources (i.e., wells, treatment equipment, flowlines, etc.) are present, the operator may elect to utilize a radius of exposure which covers a larger area than would be calculated using radius of exposure formula for each component part of the drilling/completion/workover/production system.

5. For a well being drilled in an area where insufficient data exists to calculate a radius of exposure, but where H_2S could reasonably be expected to be present in concentrations in excess of 100 ppm in the gas stream, a 100 ppm radius of exposure equal to 3,000 feet shall be assumed.

T. *Zones known to contain H_2S* means geological formations in a field where prior drilling, logging, coring, testing, or producing operations have confirmed that H_2S-bearing zones will be encountered that contain 100 ppm or more of H_2S in the gas stream.

U. *Zones known not to contain H_2S* means geological formations in a field where prior drilling, logging, coring, testing, or producing operations have confirmed the absence of H_2S-bearing zones that contain 100 ppm or more of H_2S in the gas stream.

V. *Zones which can reasonably be expected to contain H_2S* means geological formations in the area which have not had prior drilling, but prior drilling to the same formations in similar field(s) within the same geologic basin indicates there is a potential for 100 ppm or more of H_2S in the gas stream.

W. *Zones which cannot reasonably be expected to contain H_2S* means geological formations in the area which have not had prior drilling, but prior drilling to the same formations in similar field(s) within the same geologic basin indicates there is not a potential for 100 ppm or more of H_2S in the gas stream.

III. Requirements

The requirements of this Order are the minimum acceptable standards with regard to H_2S operations. This Order also classifies violations as major or minor for purposes of the assessment and penalty provisions of 43 CFR part 3163, specifies the corrective action which will probably be required, and establishes the normal abatement period following detection of a major or minor violation in which the violator may take such corrective action without incurring an assessment. However, the authorized officer may, after consideration of all appropriate factors, require reasonable and necessary standards, corrective actions and abatement periods that may in some cases, vary from those specified in this Order that he/she determines to be necessary to protect public health and safety, the environment, or to maintain control of a well to prevent waste of Federal mineral resources. To the extent such standards, actions or abatement periods differ from those set forth in this Order, they may be subject to review pursuant to 43 CFR 3165.3.

A. Applications, Approvals, and Reports

Drilling

or proposed drilling operations where formations will be penetrated which have zones known to contain or which could reasonably be expected to contain concentrations of H_2S of 100 ppm or more in the gas stream. H_2S Drilling Operation Plan and if the applicability criteria in section III.B.1 are met, a Public Protection Plan as outlined in section III.B.2.b, shall be submitted as part of the Application for Permit to Drill (APD) (refer to Oil and Gas Order No. 1). In cases where multiple filings are being made with a single drilling plan, a single H_2S Drilling Operations Plan and, if applicable, a single Public Protection Plan may be submitted for the lease, communitization agreement, unit or field in accordance with Order No. 1. Failure to submit either the H_2S Drilling Operations Plan or the Public Protecuon Plan when required by this Order shall result in an incomplete APD pursuant to 43 CFR 3162.3–1.

The H_2S Drilling Operations Plan shall fully describe the manner in which the requirements and minimum standards in section III.C. shall be met and implemented. As required by this Order (section III.C.), the following must be mitted in the H_2S Drilling Operations n:

a. Statement that all personnel shall receive proper H_2S training in accordance with section III.C.3.a.

b. A legible well site diagram of accurate scale (may be included as part of the Well Site Layout as required by Onshore Order No. 1) showing the following:

i. Drill rig orientation

ii. Prevailing wind direction

iii. Terrain of surrounding area

iv. Location of all briefing areas (designate primary briefing area)

v. Location of access road(s) (including secondary egress)

vi. Location of flare line(s) and pit(s)

vii. Location of caution and/or danger signs

viii. Location of wind direction indicators

c. As required by this Order, a complete description of the following H_2S safety equipment/systems:

i. Well control equipment.

—Flare line(s) and means of ignition
—Remote controlled choke
—Flare gun/flares
—Mud-gas separator and rotating head (if exploratory well)

. Protective equipment for essential sonnel.

—Location, type, storage and maintenance of all working and escape breathing apparatus
—Means of communication when using protective breathing apparatus

iii. H_2S detection and monitoring equipment.

—H_2S sensors and associated audible/visual alarm(s)
—Portable H_2S and SO_2 monitor(s)

iv. Visual warning systems.

—Wind direction indicators
—Caution/danger sign(s) and flag(s)

v. Mud program.

—Mud system and additives
—Mud degassing system

vi. Metallurgy.

—Metallurgical properties of all tubular goods and well control equipment which could be exposed to H_2S (section III.C.4.c.)

vii. Means of communication from wellsite.

d. Plans for well testing.

2. Production

a. For each existing production facility having an H_2S concentration of 100 ppm or more in the gas stream, the operator shall calculate and submit the calculations to the authorized officer within 180 days of the effective date of this Order, the 100 and, if applicable, the 500 ppm radii of exposure for all facilities to determine if the applicability criteria section III.B.1. of this order are met. Radii of exposure calculations shall not be required for oil or water flowlines. Further, if any of the applicability criteria (section III.B.1.) are met, the operator shall submit a complete Public Protection Plan which meets the requirements of section III.B.2.b. to the authorized officer within 1 year of the effective date of this Order. For production facilities constructed after the effective date of this Order and meeting the above minimum concentration (100 ppm in gas stream), the operator shall report the radii of exposure calculations, and if the applicability criteria (section III.B.1) are met, submit a complete Public Protection Plan (section III.B.2.b.) to the authorized officer within 60 days after completion of production facilities.

Violation: Minor for failure to submit required information.

Corrective Action: Submit required information (radii of exposure and/or complete Public Protection Plan).

Normal Abatement Period: 20 to 40 days.

b. The operator shall initially test the H_2S concentration of the gas stream for each well or production facility and shall make the results available to the authorized officer, upon request.

Violation: Minor.

Corrective Action: Test gas from well or production facility.

Normal Abatement Period: 20 to 40 days.

c. If operational or production alterations result in a 5% or more increase in the H_2S concentration (i.e., well recompletion, increased GOR's) or the radius of exposure as calculated under sections III.A.2.a. and III.A.2.b., notification of such changes shall be submitted to the authorized officer within 60 days after identification of the change.

Violation: Minor.

Corrective Action: Submit information to authorized officer.

Normal Abatement Period: 20 to 40 days.

3. Plans and Reports

a. H_2S Drilling Operations Plan(s) or Public Protection Plan(s) shall be reviewed by the operator on an annual basis and a copy of any necessary revisions shall be submitted to the authorized officer upon request.

Violation: Minor.

Corrective Action: Submit information to authorized officer.

Normal Abatement Period: 20 to 40 days.

b. Any release of a potentially hazardous volume of H_2S shall be reported to the authorized officer as soon as practicable, but no later than 24 hours following identification of the release.

Violation: Minor.

Corrective Action: Report undesirable event to the authorized officer.

Normal Abatement Period: 24 hours.

B. Public Protection

1. Applicability Criteria

For both drilling/completion/workover and production operations, the H_2S radius of exposure shall be determined on all wells and production facilities subject to this Order. A Public Protection Plan (Section III.B.2) shall be required when any of the following conditions apply:

a. The 100 ppm radius of exposure is greater than 50 feet and includes any occupied residence, school, church, park, school bus stop, place of business, or other areas where the public could reasonably be expected to frequent;

b. The 500 ppm radius of exposure is greater than 50 feet and includes any part of a Federal, State, County, or municipal road or highway owned and principally maintained for public use; or

c. The 100 ppm radius of exposure is equal to or greater than 3,000 feet where facilities or roads are maintained for direct public access.

Additional specific requirements for drilling/completion/workover or producing operations are described in sections III.C. and III.D. of this Order, respectively.

2. Public Protection Plan

a. Plan Submission/Implementation/Availability—i. A Public Protection Plan providing details of actions to alert and protect the public in the event of a release of a potentially hazardous volume of H_2S shall be submitted to the authorized officer as required by Section III.A.1. for drilling or by section III.A.2.a. for producing operations when the applicability criteria established in section III.B.1. of this Order are met. One plan may be submitted for each well, lease, communitization agreement, unit, or field, at the operator's discretion. The Public Protection Plan shall be maintained and updated, in accordance with section III.A.3.a.

ii. The Public Protection Plan shall be activated immediately upon detection of release of a potentially hazardous volume of H_2S.

Violation: Major.

Corrective Action: Immediate implementation of the public protection plan.

Normal Abatement Period: Prompt correction required.

iii. A copy of the Public Protection Plan shall be available at the drilling/completion site for such wells and at the facility, field office, or with the pumper, as appropriate, for producing wells, facilities, and during workover operations.

Violation: Minor.

Corrective Action: Make copy of Plan available.

Normal Abatement Period: 24 hours (drilling/completion/workover), 5 to 7 days (production).

b. Plan Content. i. The details of the Public Protection Plan may vary according to the site specific characteristics (concentration, volume, terrain, etc.) expected to be encountered and the number and proximity of the population potentially at risk. In the areas of high population density or in other special cases, the authorized officer may require more stringent plans to be developed. These may include public education seminars, mass alert systems, and use of sirens, telephone, radio, and television depending on the number of people at risk and their location with respect to the well site.

ii. The Public Protection Plan shall include:

(a) The responsibilities and duties of key personnel, and instructions for alerting the public and requesting assistance;

(b) A list of names and telephone numbers of residents, those responsible for safety of public roadways, and individuals responsible for the safety of occupants of buildings within the 100 ppm radius of exposure (e.g. school principals, building managers, etc.) as defined by the applicability criteria in section III.B.1. The operator shall ensure that those who are at the greatest risk are notified first. The plan shall define when and how people are to be notified in case of an H_2S emergency.

(c) A telephone call list (including telephone numbers) for requesting assistance from law enforcement, fire department, and medical personnel and Federal and State regulatory agencies, as required. Necessary information to be communicated and the emergency responses that may be required shall be listed. This information shall be based on previous contacts with these organizations;

(d) A legible 100 ppm (or 3,000 feet, if conditions unknown) radius plat of all private and public dwellings, schools, roads, recreational areas, and other areas where the public might reasonably be expected to frequent;

(e) Advance briefings, by visit, meeting or letter to the people identified in section III.B.2.b.ii(b), including:

—Hazards of H_2S and SO_2;
—Necessity for an emergency action plan;
—Possible sources of H_2S and SO_2;
—Instructions for reporting a leak to the operator;
—The manner in which the public shall be notified of an emergency; and
—Steps to be taken in case of an emergency, including evacuation of any people;

(f) Guidelines for the ignition of the H_2S-bearing gas. The Plan shall designate the title or position of the person(s) who has the authority to ignite the escaping gas and define when, how, and by whom the gas is to be ignited;

(g) Additional measures necessary following the release of H_2S and SO_2 until the release is contained are as follows:

—Monitoring of H_2S and SO_2 levels and wind direction in the affected area;
—Maintenance of site security and access control;
—Communication of status of well control; and
—Other necessary measures as required by the authorized officer; and

(h) For production facilities, a description of the detection system(s) utilized to determine the concentration of H_2S released.

C. Drilling/Completion/Workover Requirements

1. General

a. A copy of the H_2S Drilling Operations Plan shall be available during operations at the well site beginning when the operation is subject to the terms of this Order (i.e., 3 days or 500 feet of known or probable H_2S zone).

Violation: Minor.

Corrective Action: Make copy of Plan available.

Normal Abatement Period: 24 hours.

b. Initial H_2S training shall be completed and all H_2S related safety equipment shall be installed, tested, and operational when drilling reaches a depth of 500 feet above, or 3 days prior to penetrating (whichever comes first) the first zone containing or reasonably expected to contain H_2S. A specific H_2S operations plan for completion and workover operations will not be required for approval. For completion and workover operations, all required equipment and warning systems shall be operational and training completed prior to commencing operations.

Violation: Major.

Corrective Action: Implement H_2S operational requirements, such as completion of training and/or installation, repair, or replacement of equipment, as necessary.

Normal Abatement Period: Prompt correction required.

c. If H_2S was not anticipated at the time the APD was approved, but is encountered in excess of 100 ppm in the gas stream, the following measures shall be taken:

(i) the operator shall immediately ensure control of the well, suspend drilling ahead operations (unless detrimental to well control), and obtain materials and safety equipment to bring the operations into compliance with the applicable provisions of this Order.

Violation: Major.

Corrective Action: Implement H_2S operational requirements, as applicable.

Normal Abatement Period: Prompt correction required.

ii. The operator shall notify the authorized officer of the event and the mitigating steps that have or are being taken as soon as possible, but no later than the next business day. If said notification is subsequent to actual resumption of drilling operations, the operator shall notify the authorized officer of the date that drilling was

resumed no later than the next business day.

Violation: Minor.

Corrective Action: Notify authorized officer.

Normal Abatement Period: 24 hours.

iii. It is the operator's responsibility to ensure that the applicable requirements of this Order have been met prior to the resumption of drilling ahead operations. Drilling ahead operations will not be suspended pending receipt of a written H_2S Drilling Operations Plan(s) and, if necessary, Public Protection Plan(s) provided that complete copies of the applicable Plan(s) are filed with the authorized officer for approval within 5 business days following resumption of drilling ahead operations.

Violation: Minor.

Corrective Action: Submit plans to authorization officer.

Normal Abatement Period: 5 days.

2. Locations.

a. Where practical, 2 roads shall be established, 1 at each end of the location, or as dictated by prevailing winds and terrain. If an alternate road is not practical, a clearly marked footpath shall be provided to a safe area. The purpose of such an alternate escape route is only to provide a means of egress to a safe area.

Violation: Minor.

Corrective Action: Designate or establish an alternate escape route.

Normal Abatement Period: 24 hours.

b. The alternate escape route shall be kept passable at all times.

Violation: Minor.

Corrective Action: Make alternate escape route passable.

Normal Abatement Period: 24 hours.

c. For workovers, a secondary means of egress shall be designated.

Violation: Minor.

Corrective Action: Designate secondary means of egress.

Normal Abatement Period: 24 hours.

3. Personnel Protection

a. Training Program. The operator shall ensure that all personnel who will be working at the wellsite will be properly trained in H_2S drilling and contingency procedures in accordance with the general training requirements outlined in the American Petroleum Institute's (API) *Recommended Practice (RP) 49 (April 15, 1987 or subsequent editions) for Safe Drilling of Wells Containing Hydrogen Sulfide, Section 2.* The operator also shall ensure that the training will be accomplished prior to a well coming under the terms of this Order (i.e., 3 days or 500 feet of known probable H_2S zone). In addition to the requirements of API-RP49, a minimum of an initial training session and weekly H_2S and well control drills for all personnel in each working crew shall be conducted. The initial training session for each well shall include a review of the site specific Drilling Operations Plan and, if applicable, the Public Protection Plan.

Violation: Major.

Corrective Action: Train all personnel and conduct drills.

Normal Abatement Period: Prompt correction required.

i. All training sessions and drills shall be recorded on the driller's log or its equivalent.

Violation: Minor.

Corrective Action: Record on driller's log or equivalent.

Normal Abatement Period: 24 hours.

ii. For drilling/completion/workover wells, at least 2 briefing areas shall be designated for assembly of personnel during emergency conditions, located a minimum of 150 feet from the well bore and 1 of the briefing areas shall be upwind of the well at all times. The briefing area located most normally upwind shall be designated as the "Primary Briefing Area."

Violation: Major.

Corrective Action: Designate briefing areas.

Normal Abatement Period: 24 hours.

iii. One person (by job title) shall be designated and identified to all on-site personnel as the person primarily responsible for the overall operation of the on-site safety and training programs.

Violation: Minor.

Corrective Action: Designate safety responsibilities.

Normal Abatement Period: 24 hours.

b. Protective Equipment: i. The operator shall ensure that proper respirator protection equipment program is implemented, in accordance with the current American National Standards Institute (ANSI) Standard Z.88.2-1980 *"Practices for Respiratory Protection."* Proper protective breathing apparatus shall be readily accessible to all essential personnel on a drilling/completion/workover site. Escape and pressure-demand type working equipment shall be provided for essential personnel in the H_2S environment to maintain or regain control of the well. For pressure-demand type working equipment those essential personnel shall be able to obtain a continuous seal to the face with the equipment. The operator shall ensure that service companies have the proper respiratory protection equipment when called to the location. Lightweight, escape-type, self-contained breathing apparatus with a minimum of 5-minute rated supply shall be readily accessible at a location for the derrickman and at any other location(s) where escape from an H_2S contaminated atmosphere would be difficult.

Violation: Major.

Corrective Action: Acquire, repair, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

ii. Storage and maintenance of protective breathing apparatus shall be planned to ensure that at least 1 working apparatus per person is readily available for all essential personnel.

Violation: Major.

Corrective Action: Acquire or rearrange equipment, as necessary.

Normal Abatement Period: Prompt correction required.

iii. The following additional safety equipment shall be available for use:

(a) Effective means of communication when using protective breathing apparatus;

(b) Flare gun and flares to ignite the well;

(c) Telephone, radio, mobile phone, or any other device that provides communication from a safe area at the rig location, where practical.

Violation: Major.

Corrective Action: Acquire, repair, or replace equipment.

Normal Abatement Period: 24 hours.

c. H_2S Detection and Monitoring Equipment. i. Each drilling/completion site shall have an H_2S detection and monitoring system that automatically activates visible and audible alarms when the ambient air concentration H_2S reaches the threshold limits of 10 and 15 ppm in air, respectively. The sensors shall have a rapid response time and be capable of sensing a minimum of 10 ppm of H_2S in ambient air, with at least 3 sensing points located at the shale shaker, rig floor, and bell nipple for a drilling site and the cellar, rig floor, and circulating tanks or shale shaker for a completion site. The detection system shall be installed, calibrated, tested, and maintained in accordance with the manufacturer's recommendations.

Violation: Major.

Corrective Action: Install, repair, calibrate, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

ii. All tests of the H_2S monitoring system shall be recorded on the driller's log or its equivalent.

Violation: Minor.

Corrective Action: Record on driller's log or equivalent.

Normal Abatement Period: 24 hours.

iii. For workover operations, 1 operational sensing point shall be

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located as close to the wellbore as practical. Additional sensing points may be necessary for large and/or long-term operations.

Violation: Major.

Corrective Action: Install, repair, calibrate, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

d. Visible Warning System. i. Equipment to indicate wind direction at all times shall be installed at prominent locations and shall be visible at all times during drilling operations. At least 2 such wind direction indicators (i.e., windsocks, windvanes, pennants with tailstreamers, etc.) shall be located at separate elevations (i.e., near ground level, rig floor, and/or treetop height). At least 1 wind direction indicator shall be clearly visible from all principal working areas at all times so that wind direction can be easily determined. For completion/workover operations, 1 wind direction indicator shall suffice, provided it is visible from all principal working areas on the location. In addition, a wind direction indicator at each of the 2 briefing areas shall be provided if the wind direction indicator(s) previously required in this paragraph are not visible from the briefing areas.

Violation: Minor.

Corrective Action: Install, repair, move, or replace wind direction indicator(s), as necessary.

Normal Abatement Period: 24 hours.

ii. At any time when the terms of this Order are in effect, operational danger or caution sign(s) shall be displayed along all controlled accesses to the site.

Violation: Minor.

Corrective Action: Erect appropriate signs.

Normal Abatement Period: 24 hours.

iii. Each sign shall be painted a high-visibility red, black and white, or yellow with black lettering.

Violation: Minor.

Corrective Action: Replace or alter sign, as necessary.

Normal Abatement Period: 5 to 20 days.

iv. The sign(s) shall be legible and large enough to be read by all persons entering the well site and be placed a minimum of 200 feet but no more than 500 feet from the well site which allows vehicles to turn around at a safe distance prior to reaching the site.

Violation: Major.

Corrective Action: Replace, alter, or move sign, as necessary.

Normal Abatement Period: 24 hours.

v. The sign(s) shall read:

DANGER—POISON GAS—
HYDROGEN SULFIDE

and in smaller lettering:

Do Not Approach If Red Flag is Flying

or equivalent language if approved by the authorized officer.

Where appropriate, bilingual or multilingual danger sign(s) shall be used.

Violation: Minor.

Corrective Action: Alter sign(s) as necessary.

Normal Abatement Period: 5 to 20 days.

vi. All sign(s) and, when appropriate, flag(s) shall be visible to all personnel approaching the location under normal lighting and weather conditions.

Violation: Major.

Corrective Action: Erect or move sign(s) and/or flag(s), as necessary.

Normal Abatement Period: 24 hours.

vii. When H_2S is detected in excess of 10 ppm at any detection point, red flag(s) shall be displayed.

Violation: Major.

Corrective Action: Display red flag.

Normal Abatement Period: Prompt correction required.

e. Warning System Response. When H_2S is detected in excess of 10 ppm at any detection point, all non-essential personnel shall be moved to a safe area and essential personnel (i.e., those necessary to maintain control of the well) shall wear pressure-demand type protective breathing apparatus. Once accomplished, operations may proceed.

Violation: Major.

Corrective Action: Move non-essential personnel to safe area and mask-up essential personnel.

Normal Abatement Period: Prompt correction required.

4. Operating Procedures and Equipment

a. General/Operations. Drilling/completion/workover operations in H_2S areas shall be subject to the following requirements:

i. If zones containing in excess of 100 ppm of H_2S gas are encountered while drilling with air, gas, mist, other non-mud circulating mediums or aerated mud, the well shall be killed with a water or oil-based mud and mud shall be used thereafter as the circulating medium for continued drilling.

Violation: Major.

Corrective Action: Convert to appropriate fluid medium.

Normal Abatement Period: Prompt correction required.

ii. A flare system shall be designed and installed to safely gather and burn H_2S-bearing gas.

Violation: Major.

Corrective Action: Install flare system.

Normal Abatement Period: Prompt correction required.

iii. Flare lines shall be located as far from the operating site as feasible and in a manner to compensate for wind changes. The flare line(s) mouth(s) shall be located not less than 150 feet from the wellbore unless otherwise approved by the authorized officer. Flare lines shall be straight unless targeted with running tees.

Violation: Minor.

Corrective Action: Adjust flare line(s) as necessary.

Normal Abatement Period: 24 hours.

iv. The flare system shall be equipped with a suitable and safe means of ignition.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 24 hours.

v. Where noncombustible gas is to be flared, the system shall be provided supplemental fuel to maintain ignition.

Violation: Major.

Corrective Action: Acquire supplemental fuel.

Normal Abatement Period: 24 hours.

vi. At any wellsite where SO_2 may be released as a result of flaring of H_2S during drilling, completion, or workover operations, the operator shall make SO_2 portable detection equipment available for checking the SO_2 level in the flare impact area.

Violation: Minor.

Corrective Action: Acquire, repair, or replace equipment as necessary.

Normal Abatement Period: 24 hours to 3 days.

vii. If the flare impact area reaches a sustained ambient threshold level of 2 ppm or greater of SO_2 in air and includes any occupied residence, school, church, park, or place of business, or other area where the public could reasonably be expected to frequent, the Public Protection Plan shall be implemented.

Violation: Major.

Corrective Action: Contain SO_2 release and/or implement Public Protection Plan.

Normal Abatement Period: Prompt correction required.

viii. A remote controlled choke shall be installed for all H_2S drilling and, where feasible, for completion operations. A remote controlled valve may be used in lieu of this requirement for completion operations.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

ix. Mud-gas separators and rotating heads shall be installed and operable for exploratory wells.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: Prompt correction required.

b. Mud Program. i. A pH of 10 or above in a fresh water-base mud system shall be maintained to control corrosion, H_2S gas returns to surface, and minimize sulfide stress cracking and embrittlement unless other formation conditions or mud types justify a lesser pH level.

Violation: Major.

Corrective Action: Adjust pH.

Normal Abatement Period: Prompt correction required.

ii. Drilling mud containing H_2S gas shall be degassed in accordance with API's RP-49, § 5.14, at an optimum location for the rig configuration. These gases shall be piped into the flare system.

Violation: Major.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 24 hours.

iii. Sufficient quantities of mud additives shall be maintained on location to scavenge and/or neutralize H_2S where formation pressures are unknown.

Violation: Major.

Corrective Action: Obtain proper mud additives.

Normal Abatement Period: 24 hours.

c. *Metallurgical Equipment.* All equipment that has the potential to be exposed to H_2S shall be suitable for H_2S service. Equipment which shall meet these metallurgical standards include the drill string, casing, wellhead, blowout preventer assembly, casing head and spool, rotating head, kill lines, choke, choke manifold and lines, valves, mud-gas separators, drill-stem test tools, test units, tubing, flanges, and other related equipment.

To minimize stress corrosion cracking and/or H_2S embrittlement, the equipment shall be constructed of material whose metallurgical properties are chosen with consideration for both an H_2S working environment and the anticipated stress. The metallurgical properties of the materials used shall conform to the current National Association of Corrosion Engineers (NACE) Standard MR-01-75, *Material Requirement, Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment.* These metallurgical properties include the grade of steel, the processing method (rolled, normalized, tempered, and/or quenched), and the resulting strength properties. The working environment considerations include the H_2S concentration, the well fluid pH, and the wellbore pressures and temperatures. Elastomers, packing, and similar inner parts exposed to H_2S shall be resistant at the maximum anticipated temperature of exposure. The manufacturer's verification of design for use in an H_2S environment shall be sufficient verification of suitable service in accordance with this Order.

Violation: Major.

Corrective Action: Install, repair, or replace appropriate equipment, as necessary.

Normal Abatement Period: Prompt correction required.

d. Well Testing in an H_2S Environment. Testing shall be performed with a minimum number of personnel in the immediate vicinity which are necessary to safely and adequately operate the test equipment. Except with prior approval by the authorized officer, the drill-stem testing of H_2S zones shall be conducted only during daylight hours and formation fluids shall not be flowed to the surface (closed chamber only).

Violation: Major

Corrective Action: Terminate the well test.

Normal Abatement Period: Prompt correction required.

D. Production Requirements

1. General

a. All existing production facilities which do not currently meet the requirements and minimum standards set forth in this section shall be brought into conformance within 1 year after the effective date of this Order. All existing equipment that is in a safe working condition as of the effective date of this Order is specifically exempt from the metallurgical requirements prescribed in section III D.3.g.

Violation: Minor.

Corrective Action: Bring facility into compliance.

Normal Abatement Period: 60 days.

b. Production facilities constructed after the effective date of this Order shall be designed, constructed, and operated to meet the requirements and minimum standards set forth in this section. Any variations from the standards or established time frames shall be approved by the authorized officer in accordance with the provisions of section IV. of this Order. Except for storage tanks, a determination of the radius of exposure for all production facilities shall be made in the manner prescribed in section II. S. of this Order.

Violation: Minor.

Corrective Action: Bring facility into compliance.

Normal Abatement Period: 60 days.

c. At any production facility or storage tank(s) where the sustained ambient H_2S concentration is in excess of 10 ppm at 50 feet from the production facility or storage tank(s) as measured at ground level under calm (1 mph) conditions, the operator shall collect or reduce vapors from the system and they shall be sold, beneficially used, reinjected, or flared provided terrain and conditions permit.

Violation: Major, if a health or safety problem to the public is imminent, otherwise minor.

Corrective Action: Bring facility into compliance.

Normal Abatement Period: 3 days for major, 30 days for minor.

2. Storage Tanks.

Storage tanks containing produced fluids and utilized as part of a production operation and operated at or near atmospheric pressure, where the vapor accumulation has an H_2S concentration in excess of 500 ppm in the tank, shall be subject to the following:

a. No determination of a radius of exposure need be made for storage tanks.

b. All stairs/ladders leading to the top of storage tanks shall be chained and/or marked to restrict entry. For any storage tank(s) which require fencing (Section III.D.2.f), a danger sign posted at the gate(s) shall suffice in lieu of this requirement.

Violation: Minor.

Corrective Action: Chain or mark stair(s)/ladder(s) or post sign, as necessary.

Normal Abatement Period: 5 to 20 days.

c. A danger sign shall be posted on or within 50 feet of the storage tank(s) to alert the public of the potential H_2S danger. For any storage tank(s) which require fencing (section III.D.2.f.), a danger sign posted at the locked gate(s) shall suffice in lieu of this requirement.

Violation: Minor.

Corrective Action: Post or move sign(s), as necessary.

Normal Abatement Period: 5 to 20 days.

d. The sign(s) shall be painted in high-visibility red, black, and white. The sign(s) shall read:

DANGER—POISON GAS-HYDROGEN SULFIDE

or equivalent language if approved by the authorized officer. Where

appropriate, bilingual or multilingual warning signs shall be used.

Violation: Minor.

Corrective Action: Post, move, replace, or alter sign(s), as necessary.

Normal Abatement Period: 20 to 40 days.

e. At least 1 permanent wind direction indicator shall be installed so that wind direction can be easily determined at or approaching the storage tank(s).

Violation: Minor.

Corrective Action: Install, repair, or replace wind direction indicator, as necessary.

Normal Abatement Period: 20 to 40 days.

f. A minimum 5-foot chain-link, 5-strand barbed wire, or comparable type fence and gate(s) that restrict(s) public access shall be required when storage tanks are located within ¼ mile of or contained inside a city or incorporated limits of a town or within ¼ mile of an occupied residence, school, church, park, playground, school bus stop, place of business, or where the public could reasonably he expected to frequent.

Violation: Minor.

Corrective Action: Install, repair, or replace fence and/or gate(s), as necessary.

Normal Abatement Period: 20 to 40 days.

g. Gate(s), as required by section III.D.2.f. shall be locked when unattended by the operator.

Violation: Minor.

Corrective Action: Lock gate.

Normal Abatement Period: 24 hours.

3. Production Facilities

Production facilities containing 100 ppm or more of H_2S in the gas stream shall be subject to the following:

a. Danger signs as specified in section III.D.2.d. of this Order shall be posted on or within 50 feet of each production facility to alert the public of the potential H_2S danger. In the event the storage tanks and production facilities are located at the same site, 1 such danger sign shall suffice. Further, for any facilities which require fencing (section III.D.2.f.), 1 such danger sign at the gate(s) shall suffice in lieu of this requirement.

Violation: Minor.

Corrective Action: Post, move, or alter sign(s), as necessary.

Normal Abatement Period: 5 to 20 days.

b. Danger signs, as specified in section III.D.2.d. of this Order, shall be required for well flowlines and lease gathering lines that carry H_2S gas. Placement shall be where said lines cross public or lease roads. The signs shall be legible and shall contain sufficient additional information to permit a determination of the owner of the line.

Violation: Minor.

Corrective Action: Post, move, or alter sign(s), as necessary.

Normal Abatement Period: 5 to 20 days.

c. Fencing, as specified in section III.D.2.f., shall be required when production facilities are located within ¼ mile of or contained inside a city or incorporated limits of a town or within ¼ mile of an occupied residence, school, church, park, playground, school bus stop, place of business, or any other area where the public could reasonably be expected to frequent. Flowlines are exempted from this additional fencing requirement.

Violation: Minor.

Corrective Action: Install, repair, or replace fence, and/or gate(s), as necessary.

Normal Abatement Period: 20 to 40 days.

d. Gate(s), as required by section III.D.3.c. shall be locked when unattended by the operator.

Violation: Minor.

Corrective Action: Lock gate.

Normal Abatement Period: 24 hours.

e. Wind direction indicator(s) as specified in section III.D.2.e. of this Order shall be required. In the event the storage tanks and production facilities are located at the same site, 1 such indicator shall suffice. Flowlines are exempt from this requirement.

Violation: Minor.

Corrective Action: Install, repair, or replace wind direction indicator(s), as necessary.

Normal Abatement Period: 20 to 40 days.

f. All wells, unless produced by artificial lift, shall possess a secondary means of immediate well control through the use of appropriate christmas tree and/or downhole completion equipment. Such equipment shall allow downhole accessibility (reentry) under pressure for permanent well control operations. If the applicability criteria stated in Section III.B.1. of this Order are met, a minimum of 2 master valves shall be installed.

Violation: Minor.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 20 to 40 days.

g. All equipment shall be chosen with consideration for both a H_2S working environment and anticipated stresses. NACE Standard MR-01-75 shall be used for metallic equipment selection and, if applicable, adequate protection by chemical inhibition or other such method that controls or limits the corrosive effects of H_2S shall be used.

Violation: Minor.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 20 to 40 days.

h. Where the 100 ppm radius of exposure for H_2S includes any occupied residence, place of business, school, or other inhabited structure or any area where the public may reasonably be expected to frequent, the operator shall install automatic safety valves or shutdowns at the wellhead, or other appropriate shut-in controls for wells equipped with artificial lift.

Violation: Minor.

Corrective Action: Install, repair, or replace equipment, as necessary.

Normal Abatement Period: 20 to 40 days.

i. The automatic safety valves or shutdowns, as required by section III.D.3.h. shall be set to activate upon a release of a potentially hazardous volume of H_2S.

Violation: Major.

Corrective Action: Repair, replace or adjust equipment, as necessary.

Normal Abatement Period: Prompt correction required.

j. If the sustained ambient concentration of H_2S or SO_2 from a production facility which is venting or flaring reaches a concentration of H_2S (10ppm) or SO_2 (2ppm), respectively, at any of the following locations, the operator shall modify the production facility as approved by the authorized officer. The locations include any occupied residence, school, church, park, playground, school bus stop, place of business, or other areas where the public could reasonably be expected to frequent.

Violation: Major.

Corrective Action: Repair facility to bring into compliance.

Normal Abatement Period: Prompt correction required.

4. Public Protection.

When conditions as defined in section III.B.1. of this Order exist, a Public Protection Plan for producing operations shall be submitted to the authorized officer in accordance with section III.B.2.a. of this Order which includes the provisions of section III.B.2.b.

Violation: Minor.

Corrective Action: Submit Public Protection Plan.

Normal Abatement Period: 20 to 40 days.

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IV. Variances from Requirements

An operator may request the authorized officer to approve a variance from any of the requirements prescribed in Section III hereof. All such requests shall be submitted in writing to the appropriate authorized officer and provide information as to the circumstances which warrant approval of the variance(s) requested and the proposed alternative methods by which the related requirement(s) of minimum standard(s) are to be satisfied. The authorized officer, after considering all relevant factors, may approve the requested variance(s) if it is determined that the proposed alternative(s) meets or exceeds the objectives of the applicable requirement(s) or minimum standard(s).

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[Text Only]

Regulations (Standards - 29 CFR)

Specifications for accident prevention signs and tags. - 1910.145

Regulations (Standards - 29 CFR) - Table of Contents

• **Part Number:**	1910
• **Part Title:**	Occupational Safety and Health Standards
• **Subpart:**	J
• **Subpart Title:**	General Environmental Controls
• **Standard Number:**	1910.145
• **Title:**	Specifications for accident prevention signs and tags.

1910.145(a)

Scope.

1910.145(a)(1)

These specifications apply to the design, application, and use of signs or symbols (as included in paragraphs (c) through (e) of this section) intended to indicate and, insofar as possible, to define specific hazards of a nature such that failure to designate them may lead to accidental injury to workers or the public, or both, or to property damage. These specifications are intended to cover all safety signs except those designed for streets, highways, railroads, and marine regulations. These specifications do not apply to plant bulletin boards or to safety posters.

1910.145(a)(2)

All new signs and replacements of old signs shall be in accordance with these specifications.

1910.145(b)

Definitions. As used in this section, the word "sign" refers to a surface on prepared for the warning of, or safety instructions of, industrial workers or members of the public who may be exposed to hazards. Excluded from this definition, however, are news releases, displays commonly known as safety posters, and bulletins used for employee education.

..1910.145(c)

1910.145(c)

Classification of signs according to use -

1910.145(c)(1)

Danger signs.

1910.145(c)(1)(i)

There shall be no variation in the type of design of signs posted to warn of specific dangers and radiation hazards.

1910.145(c)(1)(ii)

All employees shall be instructed that danger signs indicate immediate danger and that special precautions are necessary.

1910.145(c)(2)

Caution signs.

1910.145(c)(2)(i)

Caution signs shall be used only to warn against potential hazards or to caution against unsafe practices.

1910.145(c)(2)(ii)

All employees shall be instructed that caution signs indicate a possible hazard against which proper precaution should be taken.

1910.145(c)(3)

Safety instruction signs. Safety instruction signs shall be used where there is a need for general instructions and suggestions relative to safety measures.

1910.145(d)

Sign design -

1910.145(d)(1)

Design features. All signs shall be furnished with rounded or blunt corners and shall be free from sharp edges, burrs, splinters, or other sharp projections. The ends or heads of bolts or other fastening devices shall be located in such a way that they do not constitute a hazard.

..1910.145(d)(2)

1910.145(d)(2)

Danger signs. The colors red, black, and white shall be those of opaque glossy samples as specified in Table 1 of Fundamental Specification of Safety Colors for CIE Standard Source "C", American National Standard Z53.1-1967, which is incorporated by reference as specified in Sec. 1910.6.

1910.145(d)(3)

[Reserved]

1910.145(d)(4)

Caution signs. Standard color of the background shall be yellow; and the panel, black with yellow letters. Any letters used against the yellow background shall be black. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard Z53.1-1967.

1910.145(d)(5)

[Reserved]

1910.145(d)(6)

Safety instruction signs. Standard color of the background shall be white; and the panel, green with white letters. Any letters used against the white background shall be black. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard, Z53.1-1967.

1910.145(d)(7)-(9)

[Reserved]

..1910.145(d)(10)

1910.145(d)(10)

Slow-moving vehicle emblem. This emblem (see fig. J-7) consists of a fluorescent yellow-orange triangle with a dark red reflective border. The yellow-orange fluorescent triangle is a highly visible color for daylight exposure. The reflective border defines the shape of the fluorescent color in daylight and creates a hollow red triangle in the path of motor vehicle headlights at night. The emblem is intended as a unique identification for, and it shall be used only on, vehicles which by design move slowly (25 m.p.h. or less) on the public roads. The emblem is not a clearance marker for wide machinery nor is it intended to replace required lighting or marking of slow-moving vehicles. Neither the color film pattern and its dimensions nor the backing shall be altered to permit use of advertising or other markings. The material, location, mounting, etc., of the emblem shall be in accordance with the American Society of Agricultural Engineers Emblem for Identifying Slow-Moving Vehicles, ASAE R276, 1967, or ASAE S276.2 (ANSI B114.1-1971), which are incorporated by reference as specified in Sec. 1910.6.

FIGURE J-7. - SLOW-MOVING VEHICLE EMBLEM
(For Figure J-7, Click Here)

1910.145(e)

Sign wordings.

1910.145(e)(1)

[Reserved]

1910.145(e)(2)

Nature of wording. The wording of any sign should be easily read and concise. The sign should contain sufficient information to be easily understood. The wording should make a positive, rather than negative suggestion and should be accurate in fact.

1910.145(e)(3)

[Reserved]

1910.145(e)(4)

Biological hazard signs. The biological hazard warning shall be used to signify the actual or potential presence of a biohazard and to identify equipment, containers, rooms, materials, experimental animals, or combinations thereof, which contain, or are contaminated with, viable hazardous agents. For the purpose of this subparagraph the term "biological hazard," or "biohazard," shall include only those infectious agents presenting a risk or potential risk to the well-being of man.

..1910.145(f)

1910.145(f)

Accident prevention tags -

1910.145(f)(1)

Scope and application.

1910.145(f)(1)(i)

This paragraph (f) applies to all accident prevention tags used to identify hazardous conditions and provide a message to employees with respect to hazardous conditions as set forth in paragraph (f)(3) of this section, or to meet the specific tagging requirements of other OSHA standards.

1910.145(f)(1)(ii)

This paragraph (f) does not apply to construction, maritime or agriculture.

1910.145(f)(2)

Definitions.

"Biological hazard" or "BIOHAZARD" means those infectious agents presenting a risk of death, injury or illness to employees.

"Major message" means that portion of a tag's inscription that is more specific than the signal word and that indicates the specific hazardous condition or the instruction to be communicated to the employee. Examples include: "High Voltage," "Close Clearance," "Do Not Start," or "Do Not Use" or a corresponding pictograph used with a written text or alone.

"Pictograph" means a pictorial representation used to identify a hazardous condition or to convey a safety instruction.

"Signal word" means that portion of a tag's inscription that contains the word or words that are intended to capture the employee's immediate attention.

"Tag" means a device usually made of card, paper, pasteboard, plastic or other material used to identify a hazardous condition.

1910.145(f)(3)

Use. Tags shall be used as a means to prevent accidental injury or illness to employees who are exposed to hazardous or potentially hazardous conditions, equipment or operations which are out of the ordinary, unexpected or not readily apparent. Tags shall be used until such time as the identified hazard is eliminated or the hazardous operation is completed. Tags need not be used where signs, guarding or other positive means of protection are being used.

1910.145(f)(4)

General tag criteria. All required tags shall meet the following criteria:

1910.145(f)(4)(i)

Tags shall contain a signal word and a major message.

1910.145(f)(4)(i)(A)

The signal word shall be either "Danger," "Caution," or "Biological Hazard," "BIOHAZARD," or the biological hazard symbol.

1910.145(f)(4)(i)(B)

The major message shall indicate the specific hazardous condition or the instruction to be communicated to the employee.

..1910.145(f)(4)(ii)

1910.145(f)(4)(ii)

The signal word shall be readable at a minimum distance of five feet (1.52 m) or such greater distance as warranted by the hazard.

1910.145(f)(4)(iii)

The tag's major message shall be presented in either pictographs, written text or both.

1910.145(f)(4)(iv)

The signal word and the major message shall be understandable to all employees who may be exposed to the identified hazard.

1910.145(f)(4)(v)

All employees shall be informed as to the meaning of the various tags used throughout the workplace and what special precautions are necessary.

1910.145(f)(4)(vi)

Tags shall be affixed as close as safely possible to their respective hazards by a positive means such as string, wire, or adhesive that prevents their loss or unintentional removal.

1910.145(f)(5)

Danger tags. Danger tags shall be used in major hazard situations where an immediate hazard presents a threat of death or serious injury to employees. Danger tags shall be used only in these situations.

1910.145(f)(6)

Caution tags. Caution tags shall be used in minor hazard situations where a non-immediate or potential hazard or unsafe practice presents a lesser threat of employee injury. Caution tags shall be used only in these situations.

..1910.145(f)(7)

1910.145(f)(7)

Warning tags. Warning tags may be used to represent a hazard level between "Caution" and "Danger," instead of the required "Caution" tag, provided that they have a signal word of "Warning," an appropriate major message, and otherwise meet the general tag criteria of paragraph (f)(4) of this section.

1910.145(f)(8)

Biological hazard tags.

1910.145(f)(8)(i)

Biological hazard tags shall be used to identify the actual or potential presence of a biological hazard and to identify equipment, containers, rooms, experimental animals, or combinations thereof, that contain or are contaminated with hazardous biological agents.

1910.145(f)(8)(ii)

The symbol design for biological hazard tags shall conform to the design shown below:

BIOLOGICAL HAZARD SYMBOL CONFIGURATION
(For Illustration, Click Here)

1910.145(f)(9)

Other tags. Other tags may be used in addition to those required by this paragraph (f), or in other situations where this paragraph (f) does not require tags, provided that they do not detract from the impact or visibility of the signal word and major message of any required tag.

[61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

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Regulations (Standards - 29 CFR)

Recommended color coding - 1910.145(f) App A

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• **Part Number:**	1910
• **Part Title:**	Occupational Safety and Health Standards
• **Subpart:**	J
• **Subpart Title:**	General Environmental Controls
• **Standard Number:**	1910.145(f) App A
• **Title:**	Recommended color coding

While the standard does not specifically mandate colors to be used on accident prevention tags, the following color scheme is recommended by OSHA for meeting the requirements of this section:

"DANGER" - Red, or predominantly red, with lettering or symbols in a contrasting color.

"CAUTION" - Yellow, or predominantly yellow, with lettering or symbols in a contrasting color.

"WARNING" - Orange, or predominantly orange, with lettering or symbols in a contrasting color.

"BIOLOGICAL HAZARD" - Fluorescent orange or orange-red, or predominantly so, with lettering or symbols in a contrasting color.

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References for further information - 1910.145(f) App B

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• **Part Number:**	1910
• **Part Title:**	Occupational Safety and Health Standards
• **Subpart:**	J
• **Subpart Title:**	General Environmental Controls
• **Standard Number:**	1910.145(f) App B
• **Title:**	References for further information

The following references provide information which can be helpful in understanding the requirements contained in various sections of the standard:

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2. Dreyfuss, H., Symbol Sourcebook, McGraw Hill; New York, NY, 1972.

3. Glass, R.A. and others, Some Criteria for Colors and Signs in Workplaces, National Bureau of Standards, Washington DC, 1983.

4. Graphic Symbols for Public Areas and Occupational Environments, Treasury Board of Canada, Ottawa, Canada, July 1980.

5. Howett, G.L., Size of Letters Required for Visibility as a Function of Viewing Distance and Observer Acuity, National Bureau of Standards, Washington DC, July 1983.

6. Lerner, N.D. and Collins, B.L., The Assessment of Safety Symbol Understandability by Different Testing Methods, National Bureau of Standards, Washington DC, 1980.

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8. Modley, R. and Meyers, W. R., Handbook of Pictorial Symbols, Dover Publication, New York, NY, 1976.

9. Product Safety Signs and Labels, FMC Corporation, Santa Clara, CA, 1978.

10. Safety Color Coding for Marking Physical Hazards, Z53.1, American National Standards Institute, New York, NY, 1979.

11. Signs and Symbols for the Occupational Environment, Can. 3-Z-321-77, Canadian

Standards Association, Ottawa, September 1977.

12. Symbols for Industrial Safety, National Bureau of Standards, Washington DC, April 1982.

13. Symbol Signs, U.S. Department of Transportation, Washington DC, November 1974.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49749, Oct. 24, 1978; 43 FR 51759, Nov. 7, 1978; 49 FR 5322, Feb. 10, 1984; 51 FR 33260, Sept. 19, 1986; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

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The Brimstone Battles

A Houston Chronicle Special Report

HoustonChronicle.com

Stories by Jim Morris
Photography by Smiley N. Pool

The red flag at the gate leading to an oil field near Pearsall, Texas, signifies the level of hydrogen sulfide danger at a well that caught fire after an explosion in July.

ADDITIONAL COVERAGE:

Deadly gas known for centuries still threatens the workplace
Known variously over the years as swamp gas, stink damp, rotten-egg gas and hydrosulfuric acid, the compound has left a long and well-marked trail of anguish.

A sickening experience in the Kazakhstan oil fields
H2S exposure leaves engineer with severe debilitating illnesses

Brimstone Team

THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

Deadly gas known for centuries still threatens the workplace

By JIM MORRIS

In the late 18th century, workers in the sewers of Paris were dying and falling ill with such frequency that a scientific commission was appointed to investigate what had become a national scandal.

It was determined that the hapless men were suffering from two distinct conditions. One was known as the *mitte*, a painful inflammation of the eyes and mucous membranes. The other, a form of asphyxia, was called the *plomb*.

Crude chemical analyses later confirmed that the agent in both cases was hydrogen sulfide (H2S), a pungent gas given off through the decomposition of sulfur-bearing organic matter under anaerobic (oxygen-deficient) conditions.

Word about the substance traveled slowly, however, and those who heard in many cases did not respond. Two hundred years after the French commission completed its inquiry, hydrogen sulfide continues to kill and incapacitate workers under often-preventable circumstances.

"The stupid, stupid stuff I've seen," said John Rekus, an occupational health and safety consultant in suburban Baltimore. "Hydrogen sulfide is a known bad actor -- does anybody disagree? It's incontrovertible, like carbon monoxide."

Known variously over the years as swamp gas, stink damp, rotten-egg gas and hydrosulfuric acid, the compound has left a long and well-marked trail of anguish.

It felled tunnelers beneath the Thames in London in the early 19th century, Sicilian sulfur miners and West Texas oil-field workers in the early 20th.

On Jan. 4, 1924, the U.S. Public Health Service and the Bureau of Mines issued a joint warning -- identifying H2S as "one of the most toxic of the gases" -- but the message went largely unheeded.

In the ensuing decades, hog farmers were found lying face down in manure pits, refinery workers beneath tangles of piping and vessels. Lethal exposures occurred on fishing boats and in wastewater-treatment plants, tanneries and paper mills.

By 1977, the National Institute for Occupational Safety and Health felt compelled to put out yet another alert. "Hydrogen sulfide is a nearly ubiquitous, acute acting toxic substance," NIOSH reported, estimating that 125,000 American workers were at risk of exposure. "It is a leading cause of sudden death in the workplace (and is) especially dangerous when it occurs in low-lying areas or confined workspaces ... "

At the close of the millennium, H2S remains a stealthy and pernicious workplace threat. The most elementary mistakes -- inferior training, no atmospheric monitoring or respiratory protection -- are made time and again, as evidenced by these recent incidents:

· On July 12, three civilian workers died aboard the USS Harry Truman, a Navy aircraft carrier under construction at Newport News Shipbuilding in Virginia, after inhaling hydrogen sulfide and methane generated by sewage that had leaked into a pump room.

The shipyard was cited by the Occupational Safety and Health Administration for failing to educate the men about the potential hazards of confined spaces. It paid a $6,300 OSHA penalty, an amount that "doesn't even slap (the shipyard) on the hand," said Arnold Outlaw, president of United Steelworkers of America Local 8888, which represented two of the dead men.

Shipyard spokeswoman Jerri Dickseski said, "We are very much dedicated to a safe working environment here. Even before the citation from OSHA we started retraining and doing refresher courses for our employees. We will continue that."

· On Sept. 5, 1996, a strikingly similar accident occurred at the Yorktown (Va.) Naval Weapons Station, 15 miles from Newport News. In this case four contract workers died after being exposed to sewage gases -- methane, hydrogen sulfide or both -- in a holding tank on a pier. "One person was overcome and fell," said Tom Pope, OSHA area director in Norfolk. "Three people went in after him and they were overcome."

The contractor, Qualicon Corp. of Virginia Beach, paid a $125,000 OSHA penalty in March for seven confined-space violations. Qualicon also agreed to spend $25,000 on a four-year training program.

Company owner Carl Edwards said that toxicological analyses performed on the victims indicated that the gas involved was methane -- although he could not rule out hydrogen sulfide.

"The deaths were due to drowning," Edwards said. "The question was what caused the initial loss of consciousness."

(Dickseski said that this incident was mentioned in a safety bulletin distributed at Newport News Shipbuilding several months before the shipyard's own workers were killed.)

· On Jan. 4, 1996, three men -- one of them a Mexican national who had been in the United States only three weeks -- suffocated in an oil "frac" tank in rural Scurry County, Texas.

The tank, owned by Drum Transport Services of Fluvanna, held sludge produced during the testing of an exploration well and was being cleaned with hydrogen sulfide-tainted wastewater from a nearby oil field. Signs warning of the chemical's presence were posted at the field.

Again, confined-space violations were found by OSHA, and again, the tragedy was compounded when one ill-equipped worker tried to save another.

Health and safety professionals cringe when they hear about such accidents.

"Every one of these deaths could be prevented," said Dick Lemen, a consultant in suburban Atlanta who spent 26 years with NIOSH. He outlined a common scenario:

A poorly trained worker is sent into an unventilated tank with no safety harness or respirator. The employer has not bothered to test the atmosphere inside the tank, although OSHA requires it. The worker goes down, as do several would-be rescuers.

"There's still a common acceptance in the U.S. workplace that fatalities and injuries and illnesses are sometimes the normal cost of doing business," said NIOSH director Linda Rosenstock.

NIOSH is trying to chip away at this fallacy by sending out print, video and online alerts about confined spaces and other hazards. These alerts are based on detailed case studies collected by the agency and 20 states under the Fatality Assessment and Control Evaluation (FACE) program.

"We don't think these are isolated events," Rosenstock said. "We think there's usually a causal chain of circumstances."

Consultant Rekus, a former Maryland workplace regulator who wrote *The Complete Confined Spaces Handbook*, is especially critical of companies that cut corners to save a few dollars.

"These days, there is simply no excuse for not doing continuous monitoring," Rekus said. "The technology has reached the point where you can get a monitor no bigger than a pocket radio for about $1,500."

Such devices, he said, can detect hydrogen sulfide, carbon monoxide, methane and oxygen deficiencies. Most have alarms that sound when dangerous levels are reached.

"It is my position that we have wasted more money on rescue planning than we have spent on accident prevention," Rekus said.

Drum Transport appears to have failed on both counts. The accident early last year that killed Juan Guardado, Jerry McNew Jr. and the co-owner of the small oil-field trucking and disposal company, R.L. "Buddy" Drum, arose from a number of simple errors. These were brought to light in a wrongful-death lawsuit filed against Drum Transport, several well operators and a tank fabricator on behalf of Guardado's and McNew's survivors.

Buddy Drum's son, Max, who almost became the fourth casualty, testified in a deposition last April that none of the workers who entered the frac tank had an air monitor, a self-contained breathing apparatus (although the firm owned one) or a lifeline.

Max Drum acknowledged that the wastewater used to clean sludge from the bottom of the tank came from the Addison lease, where he had seen "poison gas" signs, and that no one had tested it. Questions also remain about the composition of the sludge.

Thirty-year-old Guardado was the first to collapse inside the oblong, 500-barrel tank. The others, valiantly but foolishly, went in to try to save him.

Guardado had come to West Texas from Aguas Calientes, Mexico, at the urging of his older brother, Arturo, who had worked on the Drums' cotton farm and in their trucking business for 17 years.

It was Arturo who first peered through a hole in the tank and saw the four stricken men. He smelled what he described as a "strong, stinky" odor -- the rotten-egg odor he associated with hydrogen sulfide.

Juan was lying motionless near the hole; his brother managed to pull out his upper body.

"He was bleeding from the nose and mouth," Arturo, 40, recalled in a recent interview. As he performed CPR, Arturo began to feel "kind of drunk, kind of dizzy" and was taken by ambulance to a Snyder hospital, where he spent the night.

He didn't learn of Juan's death until the following morning. "I don't think anybody told him about the danger," said Arturo, who still works for Max Drum. "Most of the time I am thinking about him."

McNew's widow, Cathy, has lost her nursing job and is struggling to raise three young children on Social Security and workers' compensation payments.

McNew and her husband -- a truck driver -- had just celebrated their second wedding anniversary when he died. His death, she has concluded, "was no accident. This should never have happened."

Drum declined comment through his attorney, John Simpson of Lubbock. During his deposition, Drum was asked by Houston attorney Glenn Douglas -- representing Juan Guardado's widow and three children in the wrongful-death action -- if he believed Drum Transport had followed OSHA's confined-space rules.

"No, sir," Drum replied.

Although Drum insisted that he never smelled hydrogen sulfide when he entered the tank, Snyder fire chief Terry McDowell, who was on the scene, reported that levels of the chemical just inside the top hatch ranged from 44 to 65 parts per million at least two hours after Juan Guardado first went down. (Death typically occurs at 500 ppm, and the OSHA-mandated exposure limit is 20 ppm).

Indeed, the helicopter crew that took off for a Snyder hospital with Buddy Drum had to return almost immediately because the fumes from his body were so potent.

The H2S accident at Drum Transport is the only fatal one among six reported last year to the Texas Railroad Commission, which regulates oil and gas exploration, production and transportation.

All told, hydrogen sulfide has killed 40 people -- 32 workers and eight members of the public -- and injured 156 in Texas since 1975, according to the Railroad Commission.

There have been numerous near-misses, among them a 14,000-ppm release in Moore County on July 13, 1996, a 50,000-ppm release in Howard County on April 1, 1995, and a release in

Bowie County on April 22, 1990, that ranged from 30,000 to 90,000 ppm and led to the evacuation of 1,500 people.

Ron Jones, a vice president with the American Petroleum Institute in Washington, said that the U.S. oil and gas industry has made "tremendous progress in addressing the acute, toxic hazards" of hydrogen sulfide. "The institute itself has done a lot of work on developing safety practices."

Additional regulation, Jones maintained, is unnecessary.

Nonetheless, OSHA last year selected H2S as one of 20 chemical "candidates for reevaluation," with the idea of lowering the exposure limit.

And there is reason to believe that segments of the oil and gas industry are not as enlightened as Jones suggests. Stephen Cansler, a safety instructor with the University of Texas Petroleum Extension Service in Houston, is troubled by the indifference some of his students display toward hydrogen sulfide.

Cansler said that certain independent drillers -- unwilling to spend money on safety equipment and training -- are "just out and out lying to service companies" preparing to go into the field. "They just don't tell them that there's H2S present."

As health and safety director for Houston-based Cameron, which manufactures, installs and repairs wellhead equipment around the world, Frank Perry abhors such behavior.

Perry speaks of hydrogen sulfide with evangelistic verve. He chaired an American National Standards Institute committee that developed a voluntary industry training standard for the chemical and has himself trained nearly 2,000 workers since 1975.

"We've got to get rid of this macho image in the oil patch, where people are actually working (around hydrogen sulfide) without appropriate personal protective equipment," Perry said. "Some of the old hands are kind of pooh-poohing the guys who are wearing it."

Reliable, pager-sized H2S detectors with alarms are available for about $300, he said, and yet it is not unusual to find an oil-field worker wearing an archaic lead acetate strip, which silently darkens when it reacts with the gas.

Such a strip is useful only insofar as it "gives the medical examiner some indication of the cause of death," Perry said. In industry parlance it is known as "autopsy tape."

Perry recently learned of a troubling new phenomenon. Because of downhole bacterial action, some previously "sweet" oil fields -- those containing little or no hydrogen sulfide -- have turned sour.

"They're starting to reopen some of these old wells," Perry said.

Although hydrogen sulfide is best known as a fast-acting killer, it can do substantial damage in sublethal doses.

Consider the case of Keith McCoy, who was rendered unconscious and nearly asphyxiated by

the gas at the Elf Atochem organic chemical plant in eastern Harris County on Nov. 9, 1995. Before the accident, McCoy was an unflagging worker, a volunteer member of the company fire brigade and hazardous-materials response team. Chemicals did not frighten him.

Today, at 40, McCoy shuffles about his Channelview home with the unsteady gait of an old man. He supports himself with a cane. He has trouble remembering the names of his four children. His vision is poor, his energy level low. He almost never gets a decent night's sleep.

His extremities are dangerously insensitive to pain. On one occasion, after a bit of yard work, his arms were covered with fire-ant bites. He felt nothing.

His thinking is so muddled that he must follow a "do and don't" list drawn up by his wife, Tammy, to get through the day.

"I was the type who went to work sick," McCoy said. "I still don't want to believe I'm hurt. I don't have any self-esteem anymore."

McCoy cannot independently recall what happened at Elf Atochem on that November morning two years ago. With the help of his wife, he gave the following account:

Shortly after 8 a.m., McCoy, who worked in plant maintenance, was assigned to drain lubricating oil from a compressor. Unaware that a malfunction in the compressor had allowed the oil to become contaminated with hydrogen sulfide, he opened a valve to drain it into a bucket and "all this stuff just came up and hit me in the face."

McCoy fell headlong into a pool of water on the concrete floor, breaking his nose. Minutes passed before anyone came to help him; by the time the first rescuer appeared, he had stopped breathing. CPR saved him.

Initially it appeared that McCoy would recover completely from his exposure, that the broken nose would be the worst of it. Then, in a couple of days, his memory began to fail. He drifted into a purgatory from which he has yet to emerge.

"He'd go in and out of consciousness," Tammy McCoy said. "In the hospital he didn't know his mother and dad. He didn't know me."

His children were strangers to him; his wife coached him with old family videos. "For a long time," she said, "he didn't think he was a part of our life."

In a lawsuit against Elf Atochem, the McCoys allege that the accident was a result of the company's eagerness to keep the plant running after a longer-than-anticipated maintenance shutdown.

The McCoys charge that hydrogen sulfide sensors were deactivated -- in some cases covered with rubber gloves -- so that alarms would not sound and bring work to a halt.

The day before the accident, they said, H2S levels near the faulty compressor had pegged a meter designed to detect up to 1,600 ppm -- three times what is usually a lethal dose.

The McCoys' Houston-based attorney, Mark Lanier, summarized his view of Elf Atochem's

safety philosophy with an old maxim: "Kill a mule, find another. Kill a worker, hire another."

Plant manager Hank Williams was reluctant to discuss the McCoys' case at length. However, he said, "We take extreme precautions when handling this material. We do not take any chances with it."

Williams said that, to his knowledge, none of the 100 or so hydrogen sulfide sensors in the plant has ever been deactivated during his 10 years there. "They (the sensors) get immediate attention if we believe there's anything wrong with them," he said.

New Orleans safety consultant Chuck Simpson had his near-fatal brush with hydrogen sulfide in an oil field near Waynesboro, Miss., in 1982.

At the time, Simpson was a pump operator for the Western Company of North America. "As I was working on this (well), I could see vapors coming off the wellhead," he said. "At one point I had to stick my head into the vapors, and I immediately got a headache. It felt like two ball peen hammers were slapped into my temples on either side."

Simpson complained to his supervisor and was ordered to keep working. A few minutes later he was caught in a noxious cloud that had billowed from the well.

Simpson's co-workers put him in the back of a pickup truck and raced to the hospital. He tried to leap out of the truck as it was moving. He vomited almost continuously.

"It was like the worst hangover you ever had, times ten," Simpson said. "It was a drunken feeling -- intense nausea, a lot of generalized pain."

In the emergency room, Simpson spotted a man he believed had caused the accident. "I chased him down the hall, dragging two IVs," Simpson said. "I was growling at him like a dog."

He spent a week in the hospital and, as far as he knows, experienced no lingering physiological effects. He did, however, suffer from anxiety attacks -- notably, a "paralyzing fear" of objects crashing into him -- for about three months following his exposure. And he had great difficulty concentrating.

Although acute hydrogen sulfide exposures such as McCoy's and Simpson's are harrowing for the victims and their families, much of the research in the past decade has focused on less-dramatic, low-dose exposures over time.

In 1990, two Finnish scientists speculated in the British Journal of Industrial Medicine that an excess of cardiovascular deaths they documented among pulp mill workers was associated with long-term exposures to hydrogen sulfide, sulfur dioxide and related substances.

Two years ago, David Richardson of the University of North Carolina School of Public Health reported in the American Journal of Industrial Medicine that a group of sewer workers chronically exposed to hydrogen sulfide appeared to have significantly lower lung functions than a control group of unexposed water-treatment plant workers.

And in a 1992 article in the Journal of Occupational Medicine and Toxicology, New Jersey

toxicologist Myron Mehlman reviewed a litany of hydrogen sulfide studies and concluded that chronic as well as acute exposures "can result in serious, permanent (or) long-lasting injuries," mainly affecting the central nervous system.

"I personally have no doubt about chronic effects," Mehlman said in an interview. "I have seen several individuals who were completely incapacitated after low-level exposures. They can't work, period."

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THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

An ancient poison and the price of progress

Pollution is often a byproduct of profit. And the deadly gas hydrogen sulfide worries geographically diverse communities because it is an unwelcome component of several profitable industries.

It lurks in West Texas oil and gas fields and East Texas gas processing plants, on Canadian ranchlands and a Hawaiian island where volcanic heat is tapped to generate electricity.

Hydrogen sulfide – H_2S in the shorthand of chemistry – kills instantly at its worst and can sicken at lesser strength. Even in tiny concentrations, it gives off a rotten-egg odor that can gag anyone unfortunate enough to get a whiff of it.

It is an inevitable result of our appetite for energy. And it is a source of sulfur, recognized so long for its valuable but volatile properties that the ancients called it brimstone – burning stone. They used it in descriptions of a fiery hell.

Hydrogen sulfide's risks cannot be eliminated, but they can be managed – for a price. It can cost millions of dollars to control, and communities that complain about H_2S exposures risk the ire of economically crucial companies.

Industries have the resources and power to bring political pressure against regulators – and have done so repeatedly when tighter hydrogen sulfide rules have been proposed.

The communities profiled in this section are separated by distance, culture and even flag. But they share a common enemy – a modern-day brimstone – hydrogen sulfide.

Death came from a cloud

A silent killer took 9 lives in 1975. Could it happen again?

DENVER CITY–Faye Bernard has preserved the note, scribbled in the looping cursive of a teen-age girl.

"Moma [sic]: I'm gonna spend the night with Dee Dee," it reads. "Love, Clara."

This brief and, as it turned out, heartbreaking missive was written on Saturday, Feb. 1, 1975, by 14-year-old Clara Peevy. She was letting her mother, Faye, know that she'd be staying with a friend, Dee Dee Patton, at the Patton home.

Faye Bernard, above, keeps a haunting reminder of the episode in her Bible: a final note from her daughter. An accidental release of hydrogen sulfide from this unremarkable-looking wellhead, right, killed nine people in 1975.

The girls, whose budding social lives revolved around the Assembly of God church, were in high spirits. There had been a revival in the West Texas town all week, and 17-year-old Dee Dee had sung If That Isn't Love on Saturday evening.

"It sounded so pretty," Bernard, 72, said recently. "It was about the prettiest she'd ever sung."

By 5:15 a.m. Sunday, Clara Peevy, Dee Dee Patton, her parents and four relatives who had spent the night with them were dead, victims of hydrogen sulfide that leaked from Arco's Willard Unit Well No. 66, about 200 feet behind the house.

A neighbor, Tom Merrill, had called to warn them that a chemical cloud had sickened his wife and might be moving their way. Still groggy in the darkness, they had suffocated seconds after rushing outside on a chilly, damp and nearly windless morning.

Five bodies–including Clara's–were found in a car, two in a pickup truck and one on the ground.

A ninth victim–19-year-old Arco employee Steve Sparger, who was responding to the leak–was found in his pickup. The position of the truck in a ditch along County Road 330 suggested that Sparger had driven into the cloud and was trying to turn around when he died.

A concrete slab is all that remains of the Patton family home, near which eight people perished when hydrogen sulfide vapors escaped from an injection well in February 1975. A ninth victim died on a nearby road.

Almost 23 years after Texas' worst hydrogen sulfide accident, all that remains of the Patton house is a cracked concrete slab. There is no memorial, no indication of any sort that lives were lost on this spot three miles north of Denver City, although the "Christmas tree" structure of Well No. 66 remains.

Fleta Taylor, 70, lives about a mile from the well, as she did in 1975. She and her husband, Ben, were spared the effects of the gas, although he died of a heart attack three weeks later.

Taylor said that the Patton family seemed oblivious–as did most other people–to the sour gas wells (those containing at least 100 parts per million of hydrogen sulfide) that had been drilled all over Yoakum County.

Merrill, who barely got his wife and two children out of their home, told Taylor after the accident that "he could hear the Pattons crying out. Of course, they didn't last long." Melvin Reed, 65, was one of the volunteer firefighters on the scene. "I can still see it like it was yesterday," he said.

A crowd of onlookers–among them several timid rescue workers–had formed by the time the firefighters arrived at about 5:30 a.m, Reed said. The gas cloud was nearly stationary, rolling ever so slightly to the south.

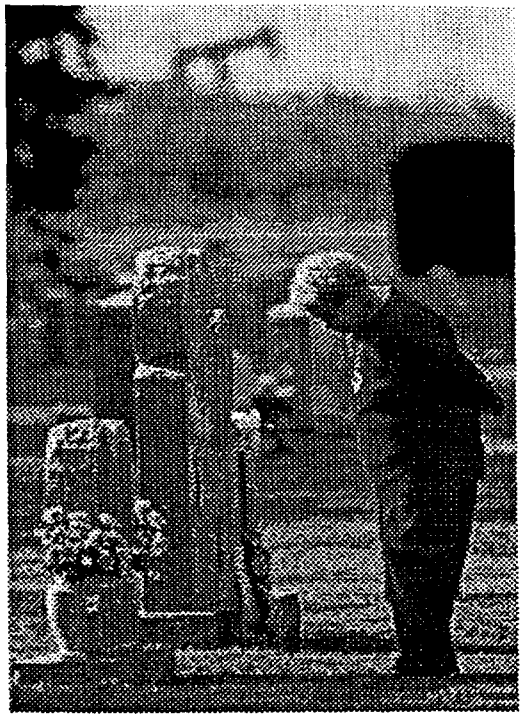
Moving in from the north, Reed and fellow firefighter Gaylon Bruton went first to the home of Ed and Verna Bagwell, who were inside, asleep, with their three children.

"We woke them up," Reed said. "If we hadn't got to them when we did, we'd have lost five more."

Pressing south, Reed and Bruton met three Arco employees at the hissing well. Arco's Don Land closed the valve, burning his hands in the process. Each of the men was wearing a self-contained breathing apparatus, although Reed removed his mask moments later to appraise the gas level.

"Everybody told me, more or less, how damned stupid I was, and I guess they were right," said Reed, who avoided injury.

He and Bruton approached the Patton house from the west; Reed was the first to go inside, finding a dead poodle under one of the beds but no people.



Faye Bernard still visits the grave of her daughter, Clara Peevy, who was killed while spending the night with her friend Dee Dee Patton.

"I got to hunting," Reed said. "I went over to the east side and that's when I saw people scattered all over out there."

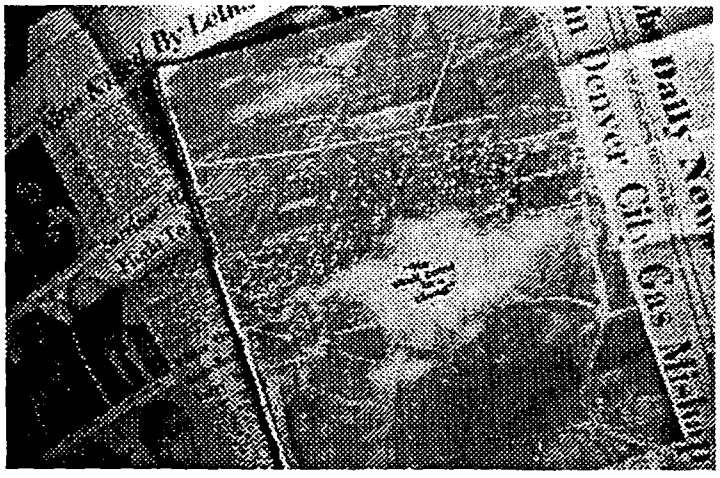
J.C. Patton was lying on the ground near the pickup, "like someone had poled him with a baseball bat." Patton's wife, Glenda, was slumped over the wheel of the car, its engine still running and its headlights on.

When it was all over, Reed openly expressed his disgust with the skittish rescue workers, the reporters and photographers who had turned the tragedy into a "freak show" and the oil companies, which, he believed, had misled the people of Denver City about the dangers of subterranean hydrogen sulfide.

Not surprisingly, Reed–a welder who did contract work for Shell Oil–became something of a pariah in a town of 5,000 whose economy was almost wholly dependent on oil and gas.

"People treated me about like a bastard child at a family reunion," he said. "If this happens again, I'm gonna be one of them damned spectators."

Clinton Bowman, editor of the biweekly Denver City Press, remembers Feb. 2, 1975, as being drizzly and cold, "one of those mornings when the clouds were really low. It was like you were in the clouds."



The back cover of a program from a revival meeting attended by Faye Bernard and her daughter eerily foreshadowed the coming tragedy. The program sits atop newspaper accounts of the incident.

Conditions were ideal for the accumulation of hydrogen sulfide, which is heavier than air and, in the absence of atmospheric circulation, seeps into low spots. All that was needed was a source.

It came in the form of a leak from Well No. 66 that, according to a meter at the nearby El Paso Natural Gas plant, began at 2:16 a.m.

The leak was caused by the failure of a stainless steel casting–called a wash nipple–that had been installed only five days earlier. Investigators later determined that it was unsuitable for use on a well containing upward of 40,000 ppm of corrosive hydrogen sulfide.

"Company does not know how this nipple got into the operation," concludes a Feb. 21, 1975, report by the Texas Railroad Commission, which regulates the state's oil and gas wells and pipelines.

The gas vented for about five hours. Volunteer firefighters and the Arco employees who shut off the well and carried out evacuations were credited with preventing more deaths. Merrill, who worked for Shell, was praised for promptly warning the Pattons and calling Sparger in the Arco office.

Had he been equipped with a respirator, the youthful, athletic Sparger might have survived and saved at least some of the eight people in the Patton home.

"Steve Sparger was one of our big football players," said Bowman, who was teaching 11th-grade history at Denver City High School in 1975. "He was the starting fullback. He was a big, nice, likable young man."

Sparger graduated in May 1973 and, as was typical in Denver City, went straight to the oil fields. He was hired as a "computer observer" by Arco and had been married only 15 months when he died.

The two investigating agencies came down hard on Arco. The Occupational Safety and Health Administration cited the company for, among other things, failing to provide Sparger with respiratory protection and adequate training.

The Railroad Commission found that Arco's safety equipment at the well was not sensitive to small leaks and that the company had no written emergency plan.

A black-and-white photograph in the Feb. 6, 1975, edition of the Denver City Press shows the upshot of these lapses: A living room left in disarray by the Pattons and their house guests.

Two pairs of eyeglasses lie on a table in the foreground. In the background are a recliner–in its horizontal position, as if someone had been sleeping on it–and a cot covered with rumpled sheets.

By the winter of 1975, oil field workers had known for decades about "rotten-egg" gas, how it could smother you in a few breaths if the concentration was high enough, how it could make you do crazy things–things a raging drunk might do–if it didn't kill you.

To the public, however, hydrogen sulfide had seemed to pose no real threat until the "white hell" (as the Press depicted the cloud) claimed nine lives in the little town just east of the New Mexico line.

It was national news, an oddity amid a numbing succession of car wrecks, plane crashes and similarly mundane disasters. The Lubbock Avalanche-Journal, the biggest daily newspaper in the area, covered the story with particular vigor, to the great irritation of Press publisher Gene Snyder.

"They had a front-page story every day for a month after it happened," said Snyder, 68, who still runs the paper. "They kept it alive, and we were trying to forget."

The story's prominence served at least one purpose: it forced the Railroad Commission to re-examine and ultimately tighten its Rule 36, which deals with the handling of hydrogen sulfide.

Drillers and producers of sour gas wells were ordered to calculate worst-case releases, plan for emergencies and warn the public. Special conditions were placed on enhanced-recovery wells, like Arco's No. 66, into which waste gas is reinjected to force out hard-to-capture oil.

"Twenty-two years ago, you didn't see no signs around saying 'Poison gas,'" said Faye Bernard's husband, Roy, whom she married after her first husband, Burl Peevy, died in 1989.

Today, Denver City is teeming with such signs, some of which can be found on the lawns of nice homes in the center of town. The signs are so plentiful, in fact, that it's easy to see how one might come to ignore them, to grow complacent about the naturally occurring chemical that contaminates oil and gas in the Wasson Field.

"This whole county, they don't want to talk about this stuff," Melvin Reed said.

In a 1993 report to Congress, the U.S. Environmental Protection Agency identified 14 "major H2S-prone areas" in 20 states. Four of these areas are in Texas.

From 1975 through 1996, 208 hydrogen sulfide incidents–significant releases from wells or pipelines that caused, or could have caused, death or injury–were reported to the Texas Railroad Commission.

On July 27, a sour well blew out southwest of San Antonio, near Pearsall. Workers on the drilling rig escaped injury, but the well burned wildly for eight days before it was capped, and hydrogen sulfide levels reached 71 ppm, enough to cause severe lung, eye and gastrointestinal maladies.

Had the blowout been mismanaged, or had it occurred in a less remote area, the outcome might have been different.

Could the Denver City tragedy be repeated? Railroad Commission Chairman Charles Matthews considers it unlikely.

"We have not had a single member of the general public killed (by hydrogen sulfide) since 1975," Matthews said. "That's a very good record."

This statistic gives little comfort to those who live near the Smackover and Pinnacle Reef natural gas formations in East Texas. Some Smackover wells have hydrogen sulfide concentrations in excess of 800,000 ppm–20 times that of Well No. 66.

The vast, deep reserves of gas in the Smackover and the Pinnacle Reef have attracted a host of exploration and production companies, some based as far away as Canada. Their wells and pipelines are going in near homes, schools and businesses, and some anxious people have organized in opposition.

They fear a recurrence of Denver City–or worse–and sense that the Railroad Commission is not taking the threat as seriously as it should.

Malakoff, a Henderson County town of 2,000, is in the thick of the Smackover play. It is also on the south side of Cedar Creek Lake, a popular retirement and recreation spot that draws crowds in the summer.

Malakoff City Administrator Jeff Looney is uneasy with the combination of sour gas production, retirees and weekend visitors.

A well blowout or a pipeline rupture on a Saturday in July could cause "mass hysteria," Looney said. "If people hear a siren, they're not going to know what's happening. We do not have the law-enforcement manpower to handle that kind of thing."

Bruce Shores regards the activity in East Texas from a unique perspective.

As principal of Malakoff Middle School, he worries about the evacuation of children in the event of a release.

As a native of Denver City, he has seen what can happen when something goes wrong. "I know the devastation that community felt," Shores said at a March 25 Railroad Commission hearing about a sour gas well near Malakoff. "I don't know if they have yet recovered."

Outwardly, at least, the town has moved on. The Press writes about the football exploits of the Denver City High Mustangs and the occasional act of vandalism. There are more wells pumping near Fleta Taylor's place today than there were when No. 66 sprang its infamous leak in 1975.

In her own subtle way, Faye Bernard has memorialized the events of that dank February morning almost 23 years ago. In addition to her daughter's last note and assorted newspaper clippings, she has kept a program distributed at the revival the night before the accident.

On one page is an aerial photograph of an unidentified town. Floating above the town are several white puffs, one of which is imprinted with an inspirational message: "He shall come in a cloud."

Religious woman that she is, Bernard prefers not to dwell on the irony.

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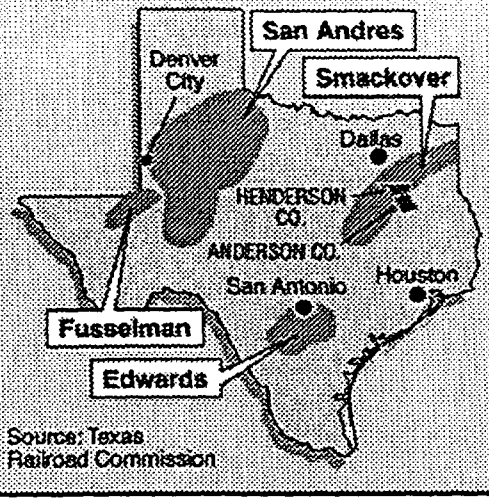
THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

Sour gas in Texas

"Sour gas," so called because it contains deadly hydrogen sulfide, is present in four large oil and natural gas formations in Texas. They are:



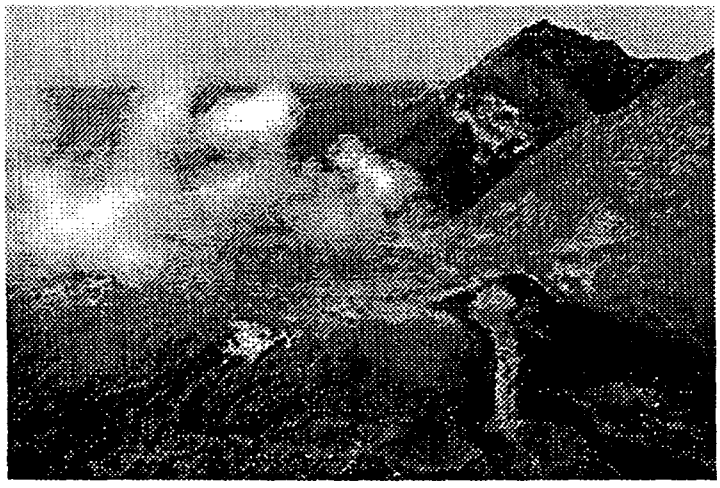
Source: Texas Railroad Commission

Poison in Paradise

Residents says operators of geothermal power plant are committing sulfuric sacrilege in goddess' garden

PUNA DISTRICT, Hawaii–This is the realm of Pele, fitful goddess of Hawaii's volcanoes.

Those who have lived on the Big Island for some time cannot help but feel the presence of the impulsive deity, who, legend has it, does not take kindly to man-made intrusions. Believers go to the rim of the gaping Kilauea crater to make offerings to her and give thanks.



Lava flows from the Pu'u O'vo vent on the southern slope of Kilauea volcano on the island of Hawaii. Kilauea is one of the most active volcanoes in the world, emitting tens of thousands of tons of sulfur dioxide each year.

It was against this mystical backdrop that an enterprise known as Puna Geothermal Venture (PGV) began punching holes in Hawaii's black volcanic rock in 1990.

Disciples of Pele warned that such drilling was blasphemous and invited ruin. PGV nonetheless went forward, having committed to a $130 million, 25-megawatt geothermal power plant that would produce electricity from subsurface heat, hastening development in one of the few relatively undisturbed pockets of the island.

Whether Pele exacted her revenge remains a matter of dispute. This, much, however, can be said:

Some residents of the lush and eclectic Puna District are convinced that hydrogen sulfide escaping from the PGV well field and power plant is making them ill.

And when a prominent Texas researcher came 4,000 miles to document the residents' symptoms in hopes of advancing knowledge about an insidious chemical, he caused an upheaval worthy of Hawaii's headstrong goddess.

"I've never encountered anything quite like it," said Dr. Marvin Legator, director of the Division of Environmental Toxicology at the University of Texas Medical Branch in Galveston.

Legator, 71, was accustomed to conflict, having often sided with community groups that had accused powerful corporations of environmental misdeeds and government agencies of

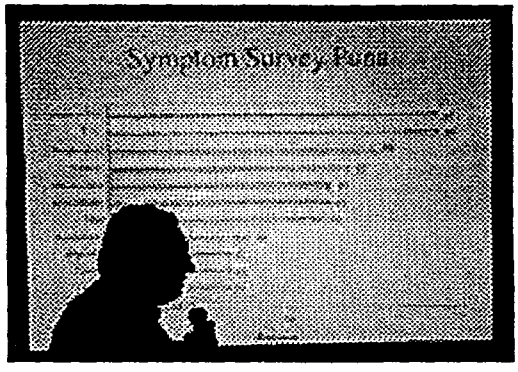
ineptitude.

Even by his standards, however, the official reception in Hawaii was chilly. It seemed that the only ones who wanted him here were the people of Leilani Estates, a rustic subdivision just south of the geothermal plant.

Most government and business leaders were less than convivial; PGV was a pet project, blessed by luminaries such as U.S. Sen. Daniel Inouye, and Legator was in a position to spoil it. At one point, there was talk of undersea cables that would carry 500 megawatts of electricity to tourist-saturated Oahu and Maui. Inouye even sought federal funds for the project, but it went nowhere.

By the time Legator entered the picture in 1996, some of the Leilani Estates residents already had organized into a group called Puna Malama Pono (rough translation: Protect the Goodness of Puna).

They had complained for years about lethargy, dizziness, insomnia, vomiting, diarrhea–the very symptoms that are associated with chronic hydrogen sulfide exposures in the medical literature and that Legator himself had observed near a synthetic-rubber plant in the West Texas city of Odessa.



Researcher Marvin Legator explains a health survey of residents near the Puna Geothermal Venture during the Big Island Science Conference at the University of Hawaii.

Legator is among a handful of researchers intrigued with the effects of minuscule–and purportedly safe–levels of hydrogen sulfide on the human body over a period of months or years.

"It's so ubiquitous, and we've had so much misleading information out there about it," he said. "If you survive (an exposure), nothing's going to happen to you–that's the dominant theory held today.

"All the regulatory agencies still hold to that same crap. The whole house of cards collapses on them when you start talking about chronic, low-level exposures, because that's where the problems are."

For Legator, Hawaii represented an unusual investigative opportunity: Here was an isolated population exposed over a period of years to generally small but quantifiable amounts of hydrogen sulfide from a known source.

In a 1981 report, three scientists at Lawrence Livermore National Laboratory in California concluded that "atmospheric releases of hydrogen sulfide constitute the most significant public health issue of geothermal energy production," and that carcinogenic and neurotoxic compounds such as benzene, arsenic, mercury and radon also could be released at levels of concern.

Two of Legator's research associates went on a scouting expedition to the Puna District in March 1996, conducting interviews with 69 people. Legator made his first visit at the beginning of this year and announced his preliminary findings–symptoms consistent with

hydrogen sulfide exposure–at a Jan. 9 news conference at the University of Hawaii at Hilo.

Legator thought he had made it clear that more work needed to be done. He realized that something was seriously amiss, however, when he read an article in the Jan. 12 edition of the Hawaii Tribune-Herald.

The headline was, "Official: Health Survey Bogus." The story quoted Bruce Anderson, deputy director of the state Department of Health in Honolulu, as saying that the results of any survey Legator conducted would be inherently biased because the subjects were rabidly anti-geothermal and had years to bone up on the effects of hydrogen sulfide.

The attacks didn't stop there. On March 26, a PGV official appealed to William Cunningham, chancellor of the University of Texas System in Austin.

"PGV is surprised and disappointed that the University of Texas would knowingly allow its fine name to be attached to a health survey of the type produced by Dr. Legator," wrote Jack Dean, the venture's vice president and general manager.

Dean did not respond to Chronicle interview requests. Legator said that he felt no pressure from either the university or the National Institute for Environmental Health Sciences–which funds research centers at UTMB and 25 other universities–to discontinue his work in Hawaii.

Still, he was so put off by the experience that he asked the Collegium Ramazzini, an international association of public-health researchers, to consider forming a defense committee for scientists browbeaten by industry.

Legator and his associates have not finished their analysis of the complete Puna District survey, given to 97 people who live near PGV and 58 members of a control group in Hilo, 20 miles away.

Nonetheless, Legator said that many members of the "exposed" group appear to have been impaired by hydrogen sulfide. "The vast majority–almost 90 percent–are showing neurotoxic effects," he said.

In an interview, Anderson said that Legator "essentially recruited individuals with known prejudices against geo-thermal power development in Hawaii.

Obviously, if you ask people who are upset about a development activity if they feel they've been affected, they're going to tell you they have.

"If there's a health problem down there, we're going to take action to address that concern," Anderson said. "If it means shutting down (PGV), so be it. But if (Legator) is alarming people needlessly, that's not a good situation either."

The saga in the Puna District began in December 1975, when the first well was drilled for the state-run Hawaii Geothermal Project, an experimental, three-megawatt power plant near Leilani Estates that went on line in 1981.

Almost from the start, residents complained about the rotten-egg stench, a sure sign that hydrogen sulfide was present.

However, when the state Health Department compared the one-year prevalence of illness in Leilani Estates with that in Hawaiian Beach Estates, a subdivision farther from the plant, it found no compelling differences–although it said that more of the Leilani Estates residents seemed to suffer from colds.

The experimental plant was closed in December 1989. But geothermal was far from dead on the Big Island.

Plans were made to drill into the East Rift Zone of the active Kilauea volcano. Transmission lines would slice through the towering Ohia trees of the Wao Kele O Puna (Green Forest of Puna), the last major rain forest in the United States.

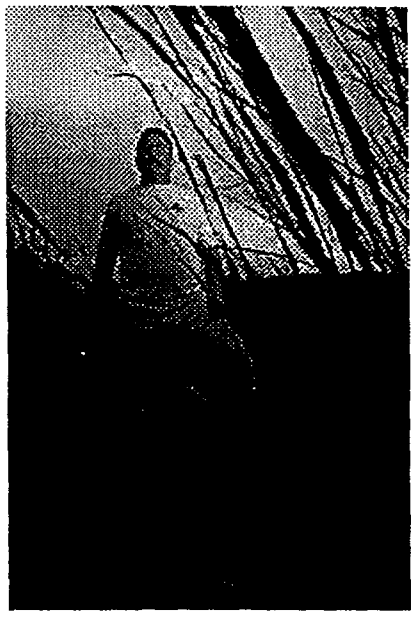
Native Hawaiians and sympathetic environmentalists were enraged by what they considered to be the supreme act of sacrilege, a defilement of Pele herself.

"If no other place in the world is like this, it has to stay like this," said Palikapu Dedman, president of the Pele Defense Fund, which organized large protests against the undersea-cable project.

The 50-year-old Dedman is a fisherman and coffee grower who takes his religious beliefs seriously. He likens geothermal drilling in sacred areas to the sacking of a Christian church.

"Our religion is something you can see and feel," Dedman said as he crouched on the edge of the Kilauea crater, in what is now Hawaii Volcanoes National Park. Steam wafted from cracks in the earth around him–proof, he said, that the volcano is a living thing.

The first PGV well was drilled in late 1990, with the blessing of Inouye, the seasoned Democratic senator and World War II hero.



Palikapu Dedman, head of the Pele Defense Fund, calls geothermal drilling a sacrilege.

Inouye had made no secret of his fondness for geothermal energy. He extolled it on the floor of the Senate on June 27, 1990, noting that Hawaii depended on 130,000 barrels of imported oil per day and needed a cleaner, more reliable source of energy as insurance.

In a letter to the Geothermal Resources Council dated Oct. 7, 1991, Inouye declined an invitation to be the keynote speaker at the group's annual meeting but promised his continued support.

"Geothermal is the most technically and economically feasible and environmentally safe energy source Hawaii has at its disposal," the senator wrote. He failed to mention that a thundering well blowout at PGV had sent a plume of hydrogen sulfide into the Puna District four months earlier.

Wilson Goddard, a consulting engineer from Lucerne, Calif., who has conducted periodic

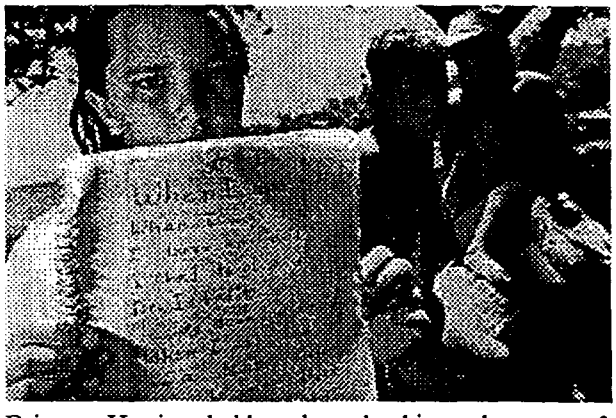
analyses of PGV since 1988, said that there is nothing inherently sinister about geothermal.

"If it's done right and in the right location, it can be benign," Goddard said. "Geothermal in Hawaii is a very powerful resource, with a very high percentage of hydrogen sulfide. The history of that (PGV) development, unfortunately, has not been good."

PGV is jointly owned by Ormat Energy Systems, an Israeli company with an office in Sparks, Nev., and Baltimore Gas & Electric.

The plant, whose output has risen from 25 to 30 megawatts, collects about 800,000 pounds of geothermal fluid (in essence, water heated by molten rock) per hour from two wells. The fluid is separated into steam, which is sent to a turbine to produce electricity, and brine, which is injected as waste into three other wells. Hydrogen sulfide levels in excess of 800 parts per million have been measured in the vapor from one of the wells.

Among the Leilani Estates residents who blame PGV for their poor health, few have suffered as much as the Harrisons, who moved here in 1986 from Southern California. Both Dru, 46, and Kate, 36, say that they are lethargic and have had cysts removed from their nasal passages. Like several other women in the neighborhood, Kate has had double menstrual cycles and sore, fibrous breasts. Dru often has blurred vision.



Brieanna Harrison holds up her school journal account of her various ailments. With her, from left, are brother Tyler, sister Kaili and mother Kate.

The three Harrison children–Brieanna, 11; Tyler, 8; and Kaili, 6–have experienced high fevers, abdominal pain and other baffling conditions. One morning not long ago, Kaili, who was born a month before the June 1991 well blowout, got out of bed and collapsed in a heap.

"She said, 'It feels like my legs aren't there, Dad,'" Dru Harrison said. He had to carry her for the better part of two days as she slowly regained her ability to walk. The family doctor attributed her temporary paralysis to viral cramping.

"Just to go through this over and over again with your children–you feel so powerless," said Kate Harrison.

Aurora Martinovich, 35, and her 11-year-old daughter Waiala live within 2,000 feet of the PGV fence in a neighborhood called Lanipuna Gardens. Another erstwhile Californian, Martinovich frets about emissions from the plant and has become one of its most vociferous critics.

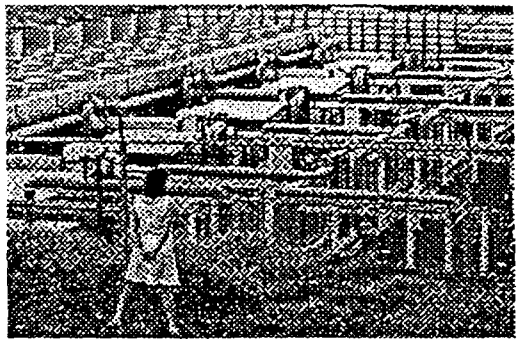
"The state has invested so much money in seducing developers out here," she said. "They're prostituting Hawaii to the highest bidder."

Martinovich and the other Puna Malama Pono members have been mocked as counterculture ne'er-do-wells who oppose all economic development.

To be sure, they are an idiosyncratic lot, a blend of dark-skinned natives and pale refugees from the mainland. Marijuana plants occasionally can be spotted amid the region's ferns and papaya trees. Pahoa, the district's dominant town, is a colorful, slightly run-down hamlet evocative of the late 1960s.

"It's arrogance, a lot of it," Leilani Estates resident Geoff Last said of the geothermal boosters. "The lowlifes in Puna can't tell them what to do."

"They're trying to label this community a bunch of radicals," said an indignant Chantele Singleton, the UTMB outreach coordinator assisting Legator with his symptom survey.



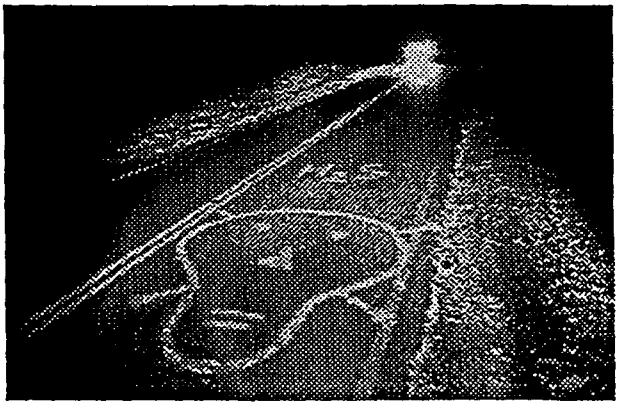
Aurora Martinovich keeps an eye on the Puna Geothermal Venture from the fenceline. Among PGV's most vocal critics, Martinovich believes the plant is emitting unhealthful levels of hydrogen sulfide.

Legator was encouraged to come to Hawaii by a colleague, Dr. Janette Sherman. An internist in Alexandria, Va., who for years saw patients in the islands, Sherman conducted a health survey of 71 people for a lawsuit filed against PGV by some of the Leilani Estates residents.

She noted in a 1993 report that many of the subjects complained of recurring ailments such as shortness of breath, swollen glands, nausea, vomiting and diarrhea.

Perhaps more significantly, 83 percent reported neuropsychiatric problems–depression, anxiety, sleeplessness–that had long been linked to hydrogen sulfide exposure. "This represents an epidemic!" Sherman wrote. "If this incidence were reported for a communicable disease, a state of emergency would be declared."

Legator submitted a study proposal–"Assisting a Community Exposed to Emissions from a Geothermal Plant"–to the environmental health sciences institute's Galveston center in March 1995 and was awarded a $5,000 grant two months later.



Graffiti painted on Pahoa-Pohoiki Road next to the Puna Geothermal Venture symbolizes the feelings of many of the plant's neighbors. Residents of the Leilani Estates subdivision blame their illnesses on hydrogen sulfide releases from the facility.

At a scientific conference at the University of Hawaii-Hilo in April, he explained the rationale behind his symptom survey: "It's nothing very much more than a physician taking a medical history so he knows where to go. It's a springboard for a more focused study."

Some attribute the Puna District illnesses to the island's naturally occurring volcanic gases.

"Emissions from the volcano make every other anthropogenic source pale by comparison," Anderson said.

Legator, however, noted that these gases consist primarily of sulfur dioxide, which affects the

body differently than hydrogen sulfide. The former tends to cause respiratory distress; the latter disrupts the central nervous system.

A 1996 report by U.S. Environmental Protection Agency suggested that PGV was a significant source of hydrogen sulfide. The agency published a list of 19 releases from the wells and the plant between February 1991 and May 1993; among these was a monstrous blowout of well KS-8 that began on June 12, 1991, and lasted 31 hours.

Goddard, the consultant, concluded that the blowout was PGV's doing, not an unavoidable act of nature, and well KS-8 was plugged.

During a 30-minute cleanout of well KS-9 on Feb. 8, 1993, hydrogen sulfide levels again soared, sickening two plant workers and five police officers off site.

In its report, the EPA criticized PGV's air monitoring and emergency planning and the state Health Department's supervision of these activities.

It noted that the EPA's San Francisco office had lodged a complaint against PGV for failing to report the 1991 and 1993 releases to the National Response Center, and that state and local officials had not received timely information about these incidents.

In an interview at his office in Hilo, Hawaii County Civil Defense Administrator Harry Kim expressed regret and revulsion over what he characterized as a government debacle.

"When I leave this job, the lowest low will be our failure to protect the people with regard to geothermal," Kim said.

The 1991 blowout "should not have happened, would not have happened if government had followed up on its responsibilities," Kim said. "This was a life-threatening situation, not an inconvenience."

Asked his opinion of Legator's health survey, he said: "The credibility of county government and state government on this issue is zero. That's why the University of Texas is here."

Things have been somewhat quieter at PGV the past few years. There have been no blowouts, although the plant's neighbors say that they still smell pungent odors–mainly at night–and worry about continuous, low-level hydrogen sulfide emissions.

"It's just there all the time," said Barbara Dettweiler, who lives with her husband, Al, about a half-mile away. "It literally dries up your throat and chokes you."

Adrian Barber was working in his Spartan office, just beyond the PGV fence, during the 1993 well-cleanout. He experienced what oil field workers call a "knockdown" from the hydrogen sulfide.

"There was no warning," said Barber, a British-born former rock 'n' roll record producer. "All of a sudden, the whole world turned vertical. It disoriented me; I'm crawling across this vertical surface to get to the door. I was vomiting. There was ringing in my ears."

Barber, president of Puna Malama Pono, is acerbic and fiercely protective of his adopted

home.

"We are the poorest island, and this is the poorest corner of that island," he said. Beneath the ground, however, lie pockets of 600-degree water with the potential to produce colossal amounts of energy.

Although the Puna District has not become the "industrial hell" Barber and his neighbors fearfully envisioned when the first PGV well was drilled seven years ago, they have not let down their guard.

Some believe that if PGV suffers no more major mishaps, if Puna Malama Pono can be held at bay, the proposed 500-megawatt leviathan might be revived by the developers.

"They've got enough heat in this volcano to make many powerful men rich beyond their wildest dreams," Barber said.

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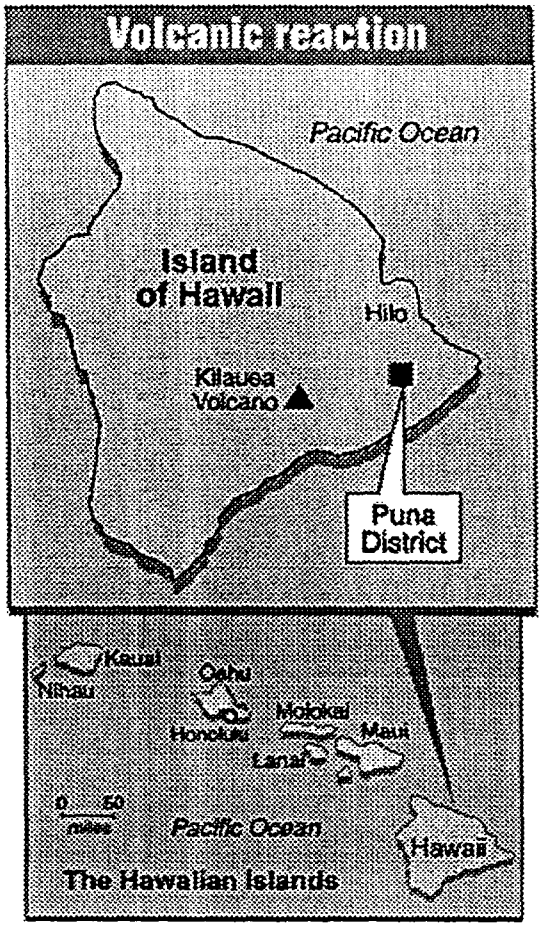
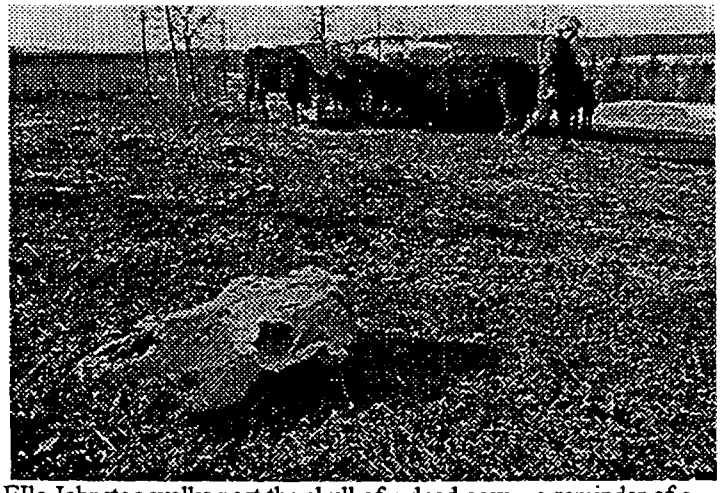


Burden of the beasts

Alberta ranchers wonder why their livestock suffer and die

ROCKY MOUNTAIN HOUSE, Alberta–It was a frigid spring afternoon, and country veterinarian Martha Kostuch had another biological riddle on her hands.



Ella Johnston walks past the skull of a dead cow – a reminder of a 1994 pipeline release. She and her husband say their herd suffers from a variety of illnesses, and skeletal remains are now common on their land near Caroline.

Before her, in a livestock trailer, lay a sick calf brought in by a rancher. The animal's belly was tight and swollen, and it was barely breathing.

Kostuch and an assistant worked frantically to relieve the calf's bloating, administering orally a green liquid called Dioctol. After a few minutes, it became evident that the animal could not be revived. Kostuch ended its misery with a lethal injection of sodium pentobarbital.

After 22 years here on the high plains of western Canada, Kostuch has come to expect, if not accept, such incidents. She has heard numerous reports of puzzling deaths, spontaneous abortions, birth defects, eye inflammation and listlessness among cattle. She has seen hardened ranchers cry.

Rocky Mountain House veterinarian Martha Kostuch works in vain to save a sick calf brought in by a rancher.

Many of the problems have occurred in areas of intensive oil and natural gas exploration, production and refining. To Kostuch and others in southwestern Alberta, this is no coincidence.

Many of the province's oil and gas fields are extremely sour–laced with hydrogen sulfide, sometimes released intact into the atmosphere but more often converted to sulfur dioxide through flaring. Both gases can play havoc with human and animal physiologies.

"No question, we're seeing chronic and acute effects," Kostuch said. She rattled them off: "Milky substance in the eyes. Difficulty breathing. Diarrhea. Neurological problems. Aggressive behavior. 'Dumb' calves that don't nurse. Poor heats. Uterine infections. Immune deficiencies."

The oil and gas industry rejects suggestions of a relationship between its operations and sickly cattle, noting that sulfur dioxide emissions are down and a recent study proved exculpatory.

"The broad public, by and large, doesn't have any burning issues with our industry," said David Pryce, manager of environment and operations for the Canadian Association of Petroleum Producers in Calgary.

In many ways, Alberta mirrors Texas with its last-frontier disposition, its agrarian roots, its vastness, its modern cities. Calgary could pass for Dallas, the rig-dotted plains near Edmonton for those near Amarillo.

There is, however, one notable difference: In Alberta, sour gas pollution is a pressing human and animal health issue, the subject of endless debate in government offices, university laboratories and small-town taverns.

In Texas, for the most part, it is still treated as an anomaly. For residents of East Texas, in the midst of a sour gas boom, Alberta's experience may be both instructive and unsettling.

The little town of Rocky Mountain House is at the center of a decades-old struggle between the province's two dominant economic forces, agriculture and energy. To the west lie the Canadian Rockies, to the south, north and east farms and ranches that, in many cases, have been in families for generations. Until sour oil and gas development began in earnest 30 or so years ago, rural Albertans had only the extremes of nature to fear. Now, they face something far more capricious.

Wayne and Ila Johnston say that they have had widespread illness in their herd of Angus cattle since 1993, when Shell Canada Ltd. began operating one of the world's largest sour gas processing plants near the town of Caroline, seven miles northwest of the Johnstons' 640 acres.

"They cough," Ila Johnston, 47, said of the animals. "They aren't doing good. The calves, when they come, are just kind of stupid."

Her 52-year-old husband described some of the deformed calves he had seen–one that was hairless, others with missing or extra limbs. A cluster of defects, he said, occurred after a Shell Canada gas pipeline rupture in January 1994.

"I had 165 head when that plant came on line," Wayne Johnston said. "I had a beautiful herd. Now it's down to 140 head and dropping.

"I used to keep a lot of cows over the age of 15. Now we can't get them to that age. Some of them will just drop dead on you."

When it began construction on the Caroline plant in 1991, Shell Canada assured its skeptical neighbors that emissions would be minimal, despite a gas stream containing, on average, 350,000 parts per million of hydrogen sulfide.

"This was supposed to be a state-of-the-art plant," Kostuch said, "but from day one they've had problems." Among them: the 1994 pipeline break and numerous "upsets"–unplanned

releases–of hydrogen sulfide, sulfur dioxide and other compounds.

The plant is allowed by permit to give off 8.5 million pounds of sulfur dioxide per year. "It's like a volcano that's erupting 24 hours a day," Wayne Johnston said.

Kostuch theorizes that all the sulfur interferes with essential trace elements–selenium, zinc, etc.–in the animals' diets, allowing deficiencies to develop.

A recently completed, five-year study funded by Shell Canada and other energy companies challenges Kostuch's hypothesis. Directed by Cheryl Waldner, a veterinarian in Sundre, researchers took one health survey of cattle before the Caroline plant opened and another after. No striking differences were found.

Shell Canada spokeswoman Laurieann Lynne said that the study was conceived and executed, without corporate interference, at the local level. "It is owned by the community, not by Shell," Lynne said.

Last spring, Shell Canada won approval from provincial regulators to increase the plant's throughput of gas, from 300 million to 360 million cubic feet per day. An appeal filed by Kostuch and the Johnstons was denied.

Sundre rancher Larry McLeod walks to his truck after picking up hay in his pasture. McLeod, citing what he believes to be a strong correlation between gas releases and problems with his cattle, gave up fighting and sold his land.

"People are very upset," Kostuch said. "Some are giving up and leaving and some are still fighting. We haven't had much civil disobedience in this province, but it's getting close."

Rancher Larry McLeod is among those who left. Through meticulous research he established what he believed to be a strong correlation between releases from sour wells, pipelines, the Shell Canada plant and a smaller Amoco plant, and reproductive problems, low weaning weights and deaths among his cattle.

"Can I one hundred-percent guarantee it? No," McLeod said. "Am I damned positive? Hell, yes. This appears to be cumulative. Cows appear to be poisoning their calves through their milk."

The sour gas activity in Alberta affects people as well as livestock.

"This industry has totally gone nuts up here," Wayne Johnston said. "When the wind comes out of the northwest, you can't think quite clearly. Your eyes water. Your ears start to ring, and the wax just turns to crap. Your emotions really get to you. It's so easy to get depressed."

Two of the Johnstons' once-unflappable neighbors are in an almost-constant state of agitation. "One of them's so riled up he's ready to shoot someone," Wayne Johnston said.

Cheryl Golding spends another day at the Walking Eagle Motor Inn with Shane, her 24-year-old son. Hydrogen sulfide emissions from drilling periodically force the two to leave their home near Rocky Mountain House and take refuge in a motel.

Drilling near their home outside Rocky Mountain House periodically forces Cheryl Golding and her 24-year-old retarded son, Shane, to take refuge in a motel. The oil companies foot the bill, but Golding has come to dread what can turn into weeks of exile.

She and her son moved here three years ago from Hardisty, an oil town in eastern Alberta. "I came out here to get some fresh air for Shane," Golding said in her room at the Walking Eagle Motor Inn. "The Welcome Wagon didn't bring a little pamphlet saying, 'You could be gassed.'"

The drilling began in the fall of 1994. Golding said that she and Shane–a frail, childlike young man who surrounds himself with stuffed animals and other toys–have since been overcome five times by hydrogen sulfide.

On one occasion, Golding said, she had the sensation of being drunk. On another she "couldn't breathe and had the most awful headache I've ever had in my life."

Shane is particularly susceptible to the gas, Golding said, because he is asthmatic and unable to care for himself.

"They tell you, 'This is for the people of Alberta,' then they come in and muck up your land," Golding said of the oil companies. "Hundreds of us are being driven out of our homes. This whole thing is just a losing proposition."

The origins of Alberta's natural-gas industry can be traced to 1890, when a shallow, non-sulfurous (sweet) well was drilled near the town of Medicine Hat, in the southeastern corner of the province. A deeper, more productive well drilled in 1904 set off a gas boom in the area, drawing international notice.

"Shortly after this discovery, the newly incorporated city of Medicine Hat acquired gas lights on its railway platforms and downtown street corners, making the headlines of Robert Ripley's Believe it or Not in the process," writes Fred Stenson in his book, Waste to Wealth: A History of Gas Processing in Canada.

When English author Rudyard Kipling came to town in 1907, Stenson writes, "The city went to elaborate lengths to entertain its celebrity, taking Kipling for a ride in a motor car, treating him to a community picnic and, the piece de resistance, a long gander at a roaring gas flare unleashed from the city's fiery bowels."

A few years later, the activity shifted to the sour fields of southwestern Alberta, where hydrogen sulfide concentrations can reach 90 percent.

There was a sour gas boom near Turner Valley in the early 1920s, another near Pincher Creek in the late 1940s. The drilling and processing (sweetening) intensified in more populous areas in the 1960s, and workers occasionally were felled by hydrogen sulfide releases.

In terms of public safety, however, the defining moment came at 2:30 p.m. on Oct. 17, 1982, when an Amoco well blew out 12 miles west of the small town of Lodgepole.

Two workers from Texas were killed, and sour gas spurted from the well for 67 days. Nauseating odors reached Edmonton, 75 miles away; people closer to the blowout reported headaches, eye irritation, nosebleeds among children and various gastrointestinal and respiratory ailments.

After a high-profile inquiry, the Alberta Energy Resources Conservation Board (now the Energy Utilities Board) concluded in 1984 that the accident "could probably have been avoided, even allowing for equipment failures, if Amoco had followed a policy of cautious drilling in the critical zone and if Amoco had been better prepared to deal with unexpected developments. The public was understandably concerned, frightened and angry about the blowout."

The inquiry set in motion a series of government initiatives designed to prevent a recurrence at an even worse location–say, on the outskirts of Calgary.

"Prior to 1984, it was primarily the industry and regulatory folks who looked after sour gas," said Dick Bissett, a petroleum consultant in Calgary. "Now we have a new ballplayer. It's called the public."

Although Cheryl Golding and others in the Rocky Mountain House area disparage it, the Energy Utilities Board has put in place a fairly elaborate system of checks and balances that applies to wells, pipelines and processing plants.

For example, operators of "critical wells"–those thought to pose the greatest risks to the public–must install redundant safety equipment, prepare detailed emergency-response plans, go door to door to warn residents of impending drilling and maintain certain setback distances from homes and public buildings.

In the event of a release, evacuation of the surrounding area becomes mandatory if the hydrogen sulfide concentration reaches 20 parts per million. Before Lodgepole, there was no standard.

"The onus is on the industry," said Marilyn Craig, program liaison leader for the Energy Utilities Board in Calgary.

Lodgepole did more than beget regulations. It seemed to embolden people who might have remained silent prior to the blowout.

Case in point: In 1991, Calgary's top public-health officials took an unprecedented stand against Canadian Occidental Petroleum, which wanted to drill in an established sour field near subdivisions in the northeastern part of the city. The officials called for more stringent setbacks than the company was proposing, and it eventually abandoned its plan.

"We took a fair bit of heat over that one," said John Pelton, director of environmental health for Calgary Health Services.

"The company took the approach that death from hydrogen sulfide was less likely than getting hit by a meteorite," said Dr. Ken Corbet, an assistant professor of community medicine at the University of Calgary who served as a consultant to the health agency. "Well, you don't compare an exposure situation like that to an act of God; it's apples and oranges. Besides, death is not the only consequence. Other health endpoints have to be considered."

The progress made in Alberta since Lodgepole has come mainly in the area of preventing catastrophic hydrogen sulfide releases. Routine emissions have received less attention.

There are new worries about sour gas flaring–in particular, the burning of an estimated 1.6 billion cubic meters of solution gas at some 5,000 crude-oil tank batteries around the province.

Once thought to be relatively harmless–compared to the discharge of uncombusted hydrogen sulfide, anyway–flaring unleashes a "cocktail of chemicals," including benzene and other carcinogens, said Tom Marr-Laing, executive director of the Pembina Institute for Appropriate Development in Drayton Valley.

"It's like peeling an onion," Marr-Laing said. "Here's another layer of issues we need to be concerned about."

In a 1996 report, the Alberta Environmental Centre chronicled the effects of hydrogen sulfide and sulfur dioxide on cattle: bronchial constriction, slow weight gain, gastrointestinal disturbances, breathing difficulties, eye irritation, increased body temperature and heart rate, and death.

The center recommended that flaring be phased out and that the effects of low doses of sulfur and other contaminants on cattle be studied "with special attention to the reproductive and immunological systems." It also called for further study of the effects of high doses released during upsets.

Industry representatives, however, argue that things are better than they seem.

Sulfur dioxide emissions from oil and gas operations in Alberta have fallen by about 75 percent in the past two decades, said Rob McManus, manager of environment and safety for the Canadian Association of Petroleum Producers. This is partly because of better control technologies, McManus said, but mainly attributable to depressed sulfur prices.

"People are trying to find sweet gas now rather than sour," he said.

The provincial government's one major attempt to answer questions about chronic, low-level hydrogen sulfide exposures came in 1985. Researchers from McGill University in Montreal conducted a three-month, $3.7 million study of 2,157 residents of Pincher Creek, in extreme southwestern Alberta.

These people had complained since the 1960s that emissions from sour gas processing plants were making them and their livestock ill. When the McGill researchers compared the Pincher Creek population to two others that presumably had not had such exposures, they found no significant differences in health status.

Debate over the study continues to this day. Did the McGill team, by refusing to conduct air monitoring and doing its work during a period of light activity at the plants, skew the data? Or were the environmental "illnesses" all in the Pincher Creek residents' heads?

Two Alberta academics have tried, with limited success, to pick up where the McGill study left off.

Dr. Tee Guidotti, director of the occupational health program at the University of Alberta in Edmonton, and Dr. Sheldon Roth, who heads the division of toxicology at the University of Calgary, have spent countless hours investigating the effects of H2S exposures.

Each has published extensively on the subject. Each displays the impatience of a scientist whose work remains incomplete.

"Biochemically, hydrogen sulfide shouldn't give you much in the way of chronic problems," Guidotti said. "But we continue to get these reports. People certainly aren't making them up."

Guidotti's interest in sour gas was piqued in the mid-1980s by accounts of "persistent neurological deficits" among workers who had survived knockdowns.

By 1990, he and Roth had crafted a grant proposal to establish a hydrogen sulfide research network in Alberta that would have included a registry of exposure victims. The cost was to be split between the sour-gas industry and the provincial government.

At the last moment, the province backed out without explanation.

"Government here is sometimes to the right of industry," Guidotti said. "There was a fear of what we might find."

Roth, for his part, has tried to discern the actions of hydrogen sulfide on the central nervous systems of young rats. He embarked on a three-year, province-funded study in 1986 that suggested the developing brain was vulnerable.

At about the same time, Dr. Rhoderick Reiffenstein of the University of Alberta was pondering the effects of high doses of hydrogen sulfide on mature rats.

Roth and Reiffenstein teamed up in 1990 and approached the Canadian Medical Research Council in Ottawa–the equivalent of the National Institutes of Health in the United States–with a proposal to continue their animal studies. They were rebuffed.

"It was kicked back as a provincial problem," Roth said. "We said it was a national problem, a global problem."

He and Reiffenstein appealed to the council and got their funding in 1991. Reiffenstein died of esophageal cancer four years later. Roth reunited with Guidotti, and the two hope to complete their unfinished business with regard to the exposure registry.

"We need to know the effects of low doses–under a part per million," said Roth, who became so passionate about hydrogen sulfide that he helped organize an international conference on it at Alberta's Banff National Park in 1989. "We need to know the aftermath of acute exposures.

It's difficult research to do."

Strong suspicions are not enough, Roth said, because "you're dealing with a gas that's produced for economic gain."

Indeed, Alberta's sour gas industry is an economic colossus that annually produces more than $4 billion in natural gas, gas liquids and elemental sulfur.

"We're trying to get the industry to quit denying that it's emitting anything dangerous," said Rob Macintosh, research and policy director for the Pembina Institute.

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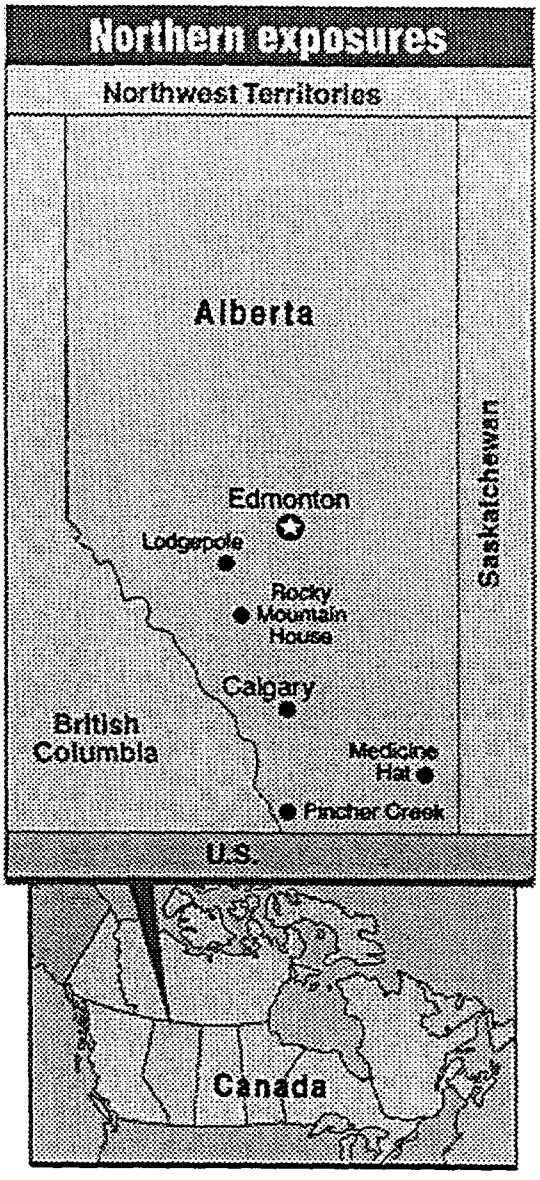
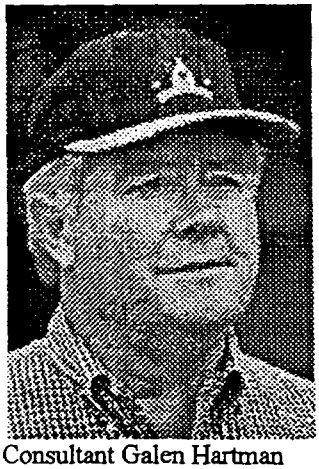




Consultant Galen Hartman of Tool has become a thorn in the side of the oil and gas industry.

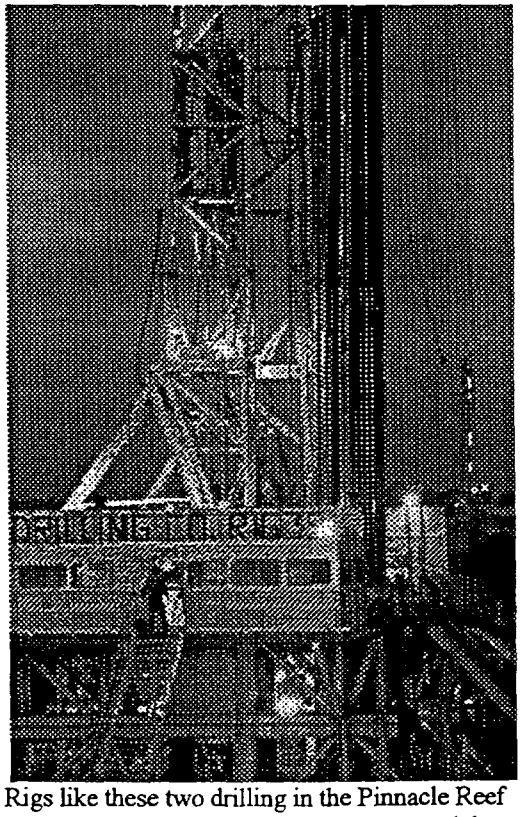
One Man's Stand

Oil and gas firms wary of bite from lonely watchdog

TOOL–Oil and gas companies tapping the extraordinarily sour fields of East Texas must brook a growing number of adversaries, but a consultant named Galen Hartman has proved particularly irksome.

Hartman, who lives on the western shore of Cedar Creek Lake in Henderson County, has a background in chemistry, likes to crunch numbers and is not afraid to speak publicly about what he calls "dry-labbing"–the concoction of data without benefit of precise laboratory analysis.

Hartman maintains that many operators in East Texas are cutting corners in this fashion, deliberately understating the worst-case accident scenarios they must prepare under the Texas Railroad Commission's Rule 36, which governs the handling of hydrogen sulfide.



Rigs like these two drilling in the Pinnacle Reef near Buffalo are an increasingly common sight across East Texas.

"The data is flawed," he said. "It's always flawed to the low side."

Such statements have made Hartman highly unpopular with some companies, notably Ultra Petroleum of Vancouver, British Columbia, which is trying to win state approval to begin producing from a dormant sour well near Tool.

In a Sept. 19 letter to Hartman, Ultra attorney John Soule charged the consultant with making inaccurate public comments about the company's contingency plan, filed with the Railroad Commission.

"Ultra takes these comments very seriously and will have to consider appropriate legal action if false statements are made in the future," Soule wrote.

Hartman's grievance centers on a document known as Railroad Commission Form H-9, which must be completed by companies wishing to drill or build pipelines or gas-processing plants in sour zones.

There is one box on the form for the hydrogen sulfide concentration in the well or pipeline, another for the "maximum escape volume" of the noxious gas.

The figures are plugged into two prescribed equations. A "radius of exposure" for a normally lethal dose of hydrogen sulfide–500 parts per million–is then calculated, as is a radius for a 100-ppm dose.

The extent of these two zones, which can be plotted as rings on a map, influences the type of contingency plan a company must develop: the greater the number of people at risk, the more intricate and potentially expensive the plan becomes.

The presence of, say, a school or a nursing home inside one of the rings further complicates the process because of the evacuation quandaries children and the elderly can create.

The East Texas wells feed processing plants such as the one operated in Henderson County by Houston-based Warren NGL Inc. and the one recently fired up in neighboring Anderson County by Pinnacle Gas Treating. At these plants, the hydrogen sulfide is extracted and converted to sulfur so the gas can be sent to consumers.

Pinnacle, a subsidiary of Denver-based Western Gas Resources, decided to build its gargantuan plant–which will be among the world's largest when it is running at capacity–about two miles from the Cayuga Independent School District's consolidated campus.

For a good part of the year, the plant will be upwind of 650 children, a situation that gave rise to considerable angst and the formation of a local group called Citizens Against Pollution (CAP) earlier this year.

The group, comprising a dozen or so property owners, was preparing to drag Pinnacle into hearings before the Railroad Commission and the Texas Natural Resource Conservation Commission when a settlement unexpectedly was announced on Aug. 7.

Pinnacle agreed to buy out its closest neighbors, reduce hydrogen sulfide emissions by installing a high-efficiency incinerator ahead of schedule and spend $215,000 on monitors, a long-term community health study and other projects.

In exchange, CAP agreed to drop its opposition to the plant. There will be no hearings.

"I wanted to stay here but I can't," said Ron Kotara, a former Cayuga High School civics teacher who agreed to sell his 40 acres to Pinnacle. "My conscience is bothering me, because nobody in this community stood up to (the company)."

On its current Form H-9, filed with the Railroad Commission on Aug. 1, Pinnacle estimates the hydrogen sulfide concentration of the gas entering the plant to be 5,000 ppm.

Based on a maximum escape volume of 700 million cubic feet per day, it predicts that a 500-ppm dose of the chemical would travel no more than 1.5 miles, a 100-ppm dose no more than 3.2 miles. The latter radius easily would include the Cayuga schools.

Hartman's figures for the plant are scarier. Assuming that the Pinnacle Reef wells feeding the plant contain 5,500 ppm of hydrogen sulfide and that the maximum escape volume is 12.6

billion cubic feet per day, Hartman determined that a 500-ppm dose could extend 9.3 miles from the plant, a 100-ppm dose 20.4 miles.

Why the big difference?

For one thing, Hartman believes 5,500 ppm to be a more accurate reflection of the hydrogen sulfide content of Pinnacle Reef wells than 5,000 ppm. More important, he and the company disagree about the maximum escape volume.

Although the plant eventually will be able to process 1.4 billion cubic feet of gas per day, Pinnacle says that its design ensures that no more than half that amount–700 million cubic feet–could come out at one time.

"We have the ability, from the plant, to shut in wells, adjust wells," said project manager Gary Davis. "We have a lot of control over our volume." Hartman, however, maintains that Pinnacle is being unrealistic about its ability to harness the incoming gas.

"If there's a catastrophic (pipeline) failure, you're going to have flow coming out of that rupture and from the wells," he said. "It will be a lot higher than 700 million cubic feet, I guarantee you."

Hartman said that the Railroad Commission should have caught the discrepancy but didn't because "they just rubber-stamp these forms." He finds it odd, for example, that three wells supplying the Pinnacle plant are shown to have identical hydrogen sulfide concentrations and maximum escape volumes.

"You will never have two wells that are exactly the same," Hartman said.

Charles Ross, a compliance specialist with the Railroad Commission's Oil and Gas Division, insisted that H-9s are checked for accuracy.

"If it's an existing field classified as sour, the district offices and Austin will both have databases listing all the (hydrogen sulfide) concentrations," Ross said. "They're going to have a good idea what range is out there."

If a well is drilled in uncharted territory, he said, a hydrogen sulfide concentration of 100 ppm is assumed and a 3,000-foot protective zone is established until specific data are available.

Because of the disquiet in East Texas, the agency's three commissioners have instructed the Oil and Gas Division to review Rule 36 "to make sure we've got the right kinds of regulations in place," said Railroad Commission Chairman Charles Matthews.

Still, Matthews cautioned, "As we continue to urbanize the state of Texas, we will have more and more conflicts between residential areas and producing areas. Prices are high, and the industry's taking another look at some of these reserves."

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And the devil that deceived them was cast into the lake of fire and brimstone . . . – **Revelation 21:10**

Brimstone–"burning stone"–is sulfur. It was so terrifying to the ancients that they used it in scriptural visions of hell thousands of years ago. The effects of its chemical relative, hydrogen sulfide, have been documented for nearly three centuries:

Ramazinni

1713: Italian physician Bernardino Ramazzini, known as "the father of occupational medicine," publishes a discussion of "Diseases of Cleaners of Privies and Cesspits" describing painful and sometimes blinding eye inflammation among such workers. Ramazzini postulates that the disturbance of excrement unleashes an acidic gas that irritates the eyes.

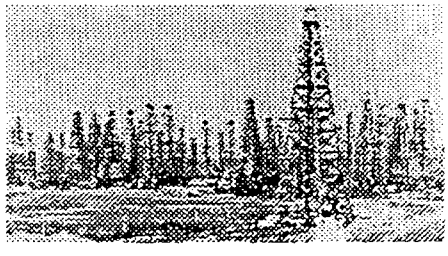
Scheele

1777: Swedish chemist Carl Wilhelm Scheele discovers hydrogen sulfide after treating ferrous sulfide with mineral acid and noting a foul odor he calls schwefelluft (sulfur air) and stinkende (stinking; fetid).

1845: In A Treatise on Poisons, Scottish physician Robert Christison writes about the effects of "hydrosulphuric acid gas," noting its acute effects: The individual becomes suddenly weak and insensible; falls down; and either expires immediately, or, if he is fortunate enough to be quickly extricated, he may revive in no long time, the belly remaining tense and full for an hour or upwards, and recovery being preceded by vomiting and hawking of bloody froth." Christison adds: "When the exposure has been too slight to cause serious mischief, the individual is affected with sickness, colic, imperfectly defined pains in the chest, and lethargy."

1862: In his novel Les Miserables, French author Victor Hugo graphically describes a series of worker deaths from "sulphuretted hydrogen" in the sewers of Paris–"a sarcophagus where asphyxia opens its claws in the filth and clutches you by the throat . . ."

1925: Yale University Professor Howard Haggard writes in the Journal of Industrial Hygiene: "Prolonged exposure to low concentrations of hydrogen sulphide is generally believed to result in a chronic form of poisoning" particularly damaging to the central nervous system and the eyes.



1929: C.M. Aves, a Houston physician, warns in the Texas State Journal of Medicine of a potent and insidious gas threatening oil field workers in West Texas. "The deaths in Texas, in the past two years, from hydrogen sulphide poisoning have been estimated from fifteen to thirty," Aves writes. "It is quite a surprise to one to find that the old 'rotten egg' gas of our laboratory days is as toxic as hydrocyanic acid, and that it is coming from nature's laboratory three thousand feet underground in such concentrations."

1950: A malfunction at a new Petroleos Mexicanos natural gas-treatment plant in Poza Rica, Mexico leads to a 20-minute release of hydrogen sulfide shortly before dawn on Nov. 24. A

temperature inversion allows a toxic fog to settle over the town and invade the sleeping residents' homes, killing 22. In all, 320 people are hospitalized.

1951: Swedish physician Gunnar Ahlborg reports in the Archives of Industrial Hygiene and Occupational Medicine that 72 percent of 459 workers regularly exposed to at least 20 parts per million of hydrogen sulfide in an oil shale plant complained of fatigue, irritability, headaches, loss of appetite, poor memory and eye irritation, among other maladies. Within a control group of 384, only 44 percent reported such conditions.

1962: Thomas Milby with the U.S. Public Health Service writes in the Journal of Occupational Medicine about the growing controversy over chronic hydrogen sulfide poisoning, noting that in "low concentrations, H2S may cause headache, fatigue, irritability, insomnia, and gastrointestinal disturbances."

1974: The Illinois Institute for Environmental Quality recommends a strict air-quality standard for hydrogen sulfide–.01 parts per million, based on an eight-hour average–marking H2S as a public-health threat at levels once thought harmless.

1978: A National Research Council subcommittee on releases a lengthy report recommending, among other things, that a national ambient emission standard for hydrogen sulfide be considered by the U.S. Environmental Protection Agency.

1995: Kaye Kilburn of the University of Southern California School of Medicine reports in Toxicology and Industrial Health that prolonged exposure to low doses of hydrogen sulfide appears to cause "persistent neurobehavioral dysfunction."

1996: Five Finnish researchers profile two towns in Finland: one polluted by a pulp mill (a source of hydrogen sulfide, sulfur dioxide and other harmful compounds) and another described as "nonpolluted." The researchers report in the Archives of Environmental Health that residents of the polluted city experienced substantially more respiratory infections, headaches and coughing than residents of the cleaner one. "These results indicated that adverse health effects of malodorous sulfur compounds occur at lower concentrations than reported previously," they write.

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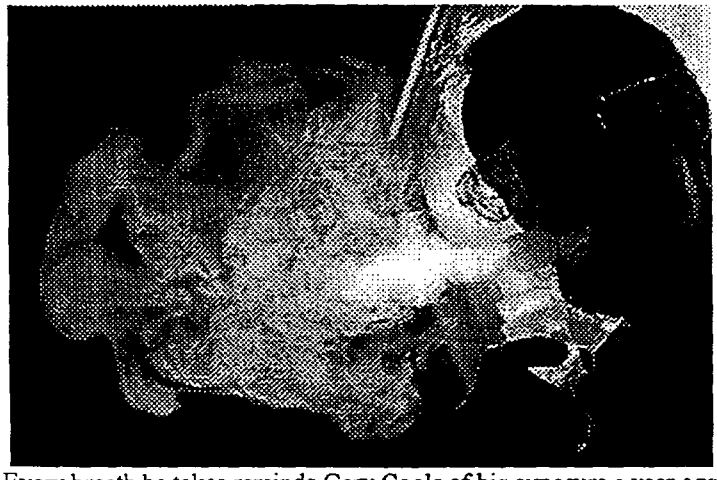
Lost Opportunity

EPA had its chance to regulate hydrogen sulfide

By JIM MORRIS



Every breath he takes reminds Gary Cools of his exposure a year ago to hydrogen sulfide, which so damaged his lungs that he must inhale medication through a nebulizer for 30-minute sessions, three times a day.

Nov. 15, 1990, was an agreeable day at the White House, a reprieve for George Bush, who had been preoccupied with the Iraqi invasion of Kuwait.

At a crowded East Room ceremony, Bush signed the Clean Air Act of 1990, an unwieldy piece of legislation that, among other things, provided for a methodical and far-reaching assault on toxic air pollutants.

"Every American expects and deserves to breathe clean air," the president said as congressional and environmental leaders looked on approvingly.

Seven years later, the federal government's crusade against air toxics is more or less on schedule. New controls are in place, or soon will be, for 188 of the most fearsome substances released in this country.

One virulent and pervasive chemical, however, fell through the cracks, over the objections of government scientists and public-interest groups. It was a casualty of an inconspicuous deal struck between Congress and an oil industry facing potentially expensive regulations.

The chemical is hydrogen sulfide (H2S), a foul, explosive gas that smells like rotten eggs and attacks the central nervous system, sometimes to lethal effect.

An 11-month Houston Chronicle investigation suggests that its deletion in 1990 from a federal Hazardous Air Pollutant list was a serious error -- although hardly an oversight -- whose full consequences have yet to be realized.

Already the gas has disrupted tens of thousands of lives in places as diverse as Los Angeles and Contra Costa County, Calif.; Corpus Christi, Beaumont, Pasadena and Ochiltree County, Texas; Tulsa and Guymon, Okla.; Detroit and Manistee, Mich.; Dakota City, Neb.; Artesia, N.M.; Pleasant Hill, Ark.; Coffeyville, Kan., and the Puna District of Hawaii.

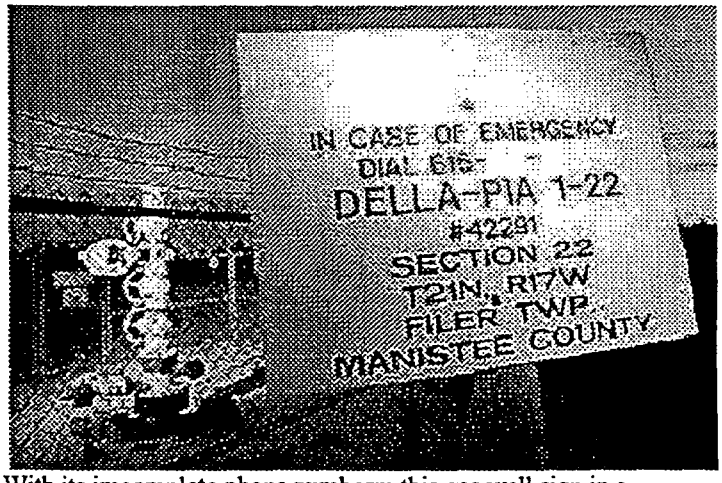
A recent example: On Sept. 18, a hydrogen sulfide leak from the Quaker Chemical Co. plant in Detroit sent 45 people -- 29 of them students at an elementary school a mile away -- to hospitals with nausea, headaches and vomiting. A Quaker official described the release, which also sickened at least six plant workers, as "minor."

A byproduct of many industrial and agricultural processes -- oil and natural gas extraction and refining, paper manufacturing, human and animal waste treatment -- hydrogen sulfide can kill in a few seconds if present in sufficient concentrations.

At lower levels it can cause headaches, fatigue, memory loss, insomnia, depression, nausea, dizziness, respiratory problems and eye irritation.

Although studies published in the past decade indicate that hydrogen sulfide is harmful in extremely low doses, the U.S. Environmental Protection Agency and most states, including Texas, have done little to control it.

Attempts at regulation have met with fierce resistance from industry, which has argued successfully that the chemical poses only intermittent risks.



With its imcomplete phone numberm this gas well sign in a residential area of Manistee, Mich., would be useless in a crisis.

As a result, hydrogen sulfide may be the least-regulated common poison in the United States, a situation that has forced some of those affected by it to turn to the courts for help.

At a noteworthy hearing on April 28, a Michigan judge condemned that state's Department of Environmental Quality for failing to protect the public from leaking "sour" oil and gas wells and pipelines -- those tainted with hydrogen sulfide.

"Who in the hell stands for the public health?" asked Circuit Judge James Batzer, presiding in a lawsuit filed by rural Filer Township against two independent exploration companies. "What do we have -- a total abdication in this state?"

Hydrogen sulfide would seem to meet the federal government's legal definition of a hazardous air pollutant: A compound that presents or may present "through inhalation or other routes of exposure, a threat of adverse human health effects ... or adverse environmental effects ... as a result of emissions to the air."

The law requires that consideration be given to chemicals that may cause cancer, birth defects, neurological damage or reproductive impairment. Such chemicals may be either acutely or chronically toxic.

And yet when the EPA put hydrogen sulfide on the Hazardous Air Pollutant list, the oil

industry lobbied successfully to have it removed. Chemicals far less prevalent, if not less toxic, stayed on.

"It was a political deal," said a former EPA official, who asked not to be identified. "Companies in Texas were very successful in removing (hydrogen sulfide) from the list because of its presence in the extraction of oil -- because of that and the voting bloc there.

"It meets the criteria (for listing). There's no question it meets the criteria."

Virginia Hughes, an EPA air-enforcement officer in Dallas, found the delisting inexplicable.

"I couldn't believe they did that," she said. "I think it was a poor scientifically based decision, extremely poor. We all know it is extremely deadly."

The curious chain of events didn't end in 1990. Two years later, when the EPA proposed that routine emissions of hydrogen sulfide merely be reported -- not controlled -- it was threatened with a lawsuit by the chemical and paper industries. The agency backed down in 1994.

Historically, hydrogen sulfide has been viewed as an exotic occupational hazard of little concern to the public.

"There was some question (in 1990) as to whether hydrogen sulfide was a pervasive enough pollutant," said Bill Harnett, associate director of the EPA's Air Quality Strategies and Standards Division at Research Triangle Park, N.C. "It was felt that there were very few sources of it."

The Chronicle's study demonstrates otherwise.

"This stuff is like asbestos -- it's everywhere," said Dr. Kaye Kilburn, a professor at the University of Southern California School of Medicine who has reported neurological effects -- imbalance, tunnel vision, inability to concentrate -- from exposures to very low concentrations of hydrogen sulfide.

"If we'd had any sense, we'd have done something about it," Kilburn said.

Indeed, the chemical's dangers have been known for centuries. One of its elemental components is sulfur, the brimstone in biblical descriptions of hell.

In his 1862 novel *Les Miserables*, French author Victor Hugo was referring to hydrogen sulfide when he described "slow asphyxia by uncleanliness" among workers in the squalid sewers of Paris.

Victims of hydrogen sulfide exposures at a minimum are afflicted with throbbing heads, stinging eyes and churning stomachs. Those who have suffered acute exposures do not forget the experience, a nightmarish fusion of drunkenness and the worst conceivable bout of stomach flu.

Gary Cools remembers stepping out the back door of his business, Manistee Auto Electric, to drink a cup of coffee and enjoy the breeze from nearby Lake Michigan the afternoon of Aug. 27, 1996.

What he got instead was a whiff of hydrogen sulfide, liberated during the plugging of a sour gas well about 100 yards away.

"We weren't advised of anything," said Cools, 47. "We heard a rush of gas coming from the wellhead area. It sounded like a jet engine."

A white cloud, reeking of rotten eggs, drifted southeast into Cools's shop and several other businesses on Parkdale Avenue in Manistee. Cools became nauseated and giddy. His eyes burned, and he couldn't draw a full breath.

Cools, his wife Judy and nine other people wound up going to the emergency room that day. Cools continues to receive treatment for breathing difficulties, has trouble sleeping and has been weakened by repeated respiratory infections.

The incident in Manistee last year is among at least 11 that have occurred since 1993 in the northwestern Lower Peninsula, a lovely resort area underlain by a deep natural gas field called the Niagaran Reef. In recent years, the reef has attracted a number of exploration and production companies, most of them small independents.

Late on the evening of May 13, 1994, a sour gas compressor station near Ludington, 30 miles south of Manistee, blew a gasket. The heavier-than-air cloud that was released and moved along the Lincoln River sickened a number of people in its path, including a woman driving across a bridge nearly five miles away.

Early the next day, Debbie Nickelson and her family awoke with headaches and nausea. "We thought it might be a bug," said Nickelson, who runs a day-care center out of her basement and was preparing for the imminent arrival of five young children.

Four of the five were overcome later that morning by hydrogen sulfide, which had accumulated overnight in the basement, and were taken to the hospital. The fifth didn't stay long enough to feel any effects.

"It was really scary," Nickelson said. "They were basically just passing out. One little girl kind of went to sleep. One little boy passed out on the kitchen floor; he started to vomit as he passed out. I had another little boy with asthma -- he was having great difficulty breathing."

No one had bothered to warn the Nickelsons -- or anyone else -- about the gas leak; those closest to it evacuated on their own, out of necessity. "The kids, they play downstairs by themselves sometimes," Debbie Nickelson said. "Would they have died if I hadn't gone down there when I did?"

Unpublicized, worst-case scenarios developed by some oil and gas companies indicate that the Michigan victims were fortunate.

In a document filed in February with the Texas Railroad Commission, for example, representatives of the Warren NGL Inc. sour gas processing plant near the East Texas town of Eustace offered their best guess about the impacts of a catastrophic pipeline rupture.

A cloud with lethal levels of hydrogen sulfide (500 parts per million) would move up to 4.3

miles from the plant, they predicted, and a 100-ppm cloud -- capable of causing serious illness -- up to 9.3 miles.

Hydrogen sulfide need not be discharged in high concentrations, however, to do harm. It can, over time, impair quality of life at levels deemed safe by most regulators.

Its offensive odor has ruined property values and literally driven people from their homes. There is evidence that it has hampered young students' performance in the classroom.

Extremely corrosive, it has consumed barbed-wire fences and the copper entrails of air conditioners. And it continues to kill poorly trained or careless workers.

Company reports to the EPA's Emergency Response Notification System show that there were 197 accidental releases of hydrogen sulfide nationwide during the first nine months of 1997. Fifty-four percent -- 107 -- of these were in Texas.

Such mishaps aren't the worst of it. In some parts of the country, routine, legal hydrogen sulfide emissions dwarf accidental releases.

In 1995, for example, the old Farmland Industries oil refinery in Coffeyville, Kan., put out 840,000 pounds of the chemical. Much of the malodorous gas settled on the city's low-income east side.

"It takes the paint off people's houses," said Nicketa Nevils, who runs a day-care center in the neighborhood. "It messes up people's roofs and air conditioners. You can smell it inside your house."

Last November, Farmland paid $1.45 million in penalties to the EPA and agreed to make $4.25 million in refinery improvements to resolve a litany of violations, among them failure to promptly report 29 accidental hydrogen sulfide releases, known as "upsets," over a four-year period.

Farmland's output of hydrogen sulfide has fallen since the 1995 peak and is expected to keep falling -- to perhaps 40,000 pounds per year -- only because an expansion project subjects it to new, stricter rules.

Had the expansion not gone forward, regulators say, the absence of federal and state standards would have tied their hands.

Farmland is not an isolated case. Navajo Refining Co. has been stinking up the southeastern New Mexico town of Artesia for many years. The Los Angeles-Long Beach and Bay Area refinery belts in California are prodigious sources of hydrogen sulfide, sometimes released in window-shattering explosions.

The chemical has repulsed neighbors of an IBP meatpacking plant in Dakota City, Neb., and the Dynagen synthetic-rubber plant in Odessa. Residents of Corpus Christi's "Refinery Row" have learned to distinguish it from the other industrial odors that drift into their homes.

Hydrogen sulfide upsets almost always are dismissed as unavoidable accidents and go unpunished by regulators, although at some plants they occur so frequently that workers and

adjacent residents come to expect and dread them.

The stakes of such releases are high because of the chemical's potency and its propensity for settling, as a pungent fog, in low spots. Motorists have been known to pass through such clouds with their windows up and emerge seconds later gasping and wretching.

Still, "people have a cavalier attitude about this chemical," said Dr. Myron Mehlman, an adjunct professor of environmental and community medicine at the Robert Wood Johnson School of Medicine in Piscataway, N.J. "They always find excuses why we can't regulate it."

In a sort of consolation prize for public-health advocates, hydrogen sulfide was proposed for and remains on an EPA "extremely hazardous substances" list drawn up for the 1990 law.

Companies that store or produce chemicals on this list must develop plans to prevent and respond to accidental releases. Routine emission controls, however, aren't part of the picture.

There was, in addition, a 1993 EPA report to Congress on hydrogen sulfide discharges associated with oil and gas production.

The study's conclusion: "From the limited data available, there appears to be no evidence that a significant threat to public health or the environment exists from routine emissions from sour oil and gas wells."

The authors didn't look at other large sources of hydrogen sulfide, such as refineries.

And their own report noted that a single tank battery in the Lone Butte Oil Field near Theodore Roosevelt National Park in North Dakota had recorded more than 3,000 violations of the state's hydrogen sulfide standard each year from 1984 through 1986.

As it stands, the chemical essentially is treated as an afterthought by the EPA: Its concentration in industrial fuel gas is limited to minimize emissions of sulfur dioxide, the lung-irritating gas created when hydrogen sulfide is burned.

The story of the federal government's failed run at hydrogen sulfide begins in the mid-1980s, by which time a groundswell had developed for an overhaul of the original Clean Air Act, passed in 1970.

Restrained by a cumbersome regulatory scheme that forced it to do elaborate risk analyses on a case-by-case basis, the EPA had made little headway against air toxics. Realizing that hundreds of pernicious compounds were threatening public health and the environment, agency officials began to rethink their strategy.

Ultimately it was decided that air-toxics regulation should be a two-step process. Industries that put out listed chemicals above certain levels are being required to employ "maximum achievable control technologies" (MACT) -- systems used by the most progressive members of a given industrial category.

After these controls are in place, the EPA will revisit each category. If it determines that there is a residual health risk, more controls will be required.

The MACT program is proceeding apace. One hundred seventy-four categories -- from dry cleaners to aerospace and organic-chemical manufacturers -- must have state-of-the-art control technologies in place by November 2000. About half already do, and the EPA estimates that this has resulted in an annual reduction of 2 billion pounds of air toxics.

What would have happened if hydrogen sulfide had stayed on the EPA's target list? The agency would have looked at industries known to pollute the air with large amounts of the chemical -- refineries, paper mills, etc. -- and probably would have set a tough but attainable emission standard, as it has or will set for much rarer compounds.

Industry resistance to controls on hydrogen sulfide is not surprising, given that compliance could be quite expensive. Harder to fathom is the reaction to a seemingly less onerous EPA proposal to add hydrogen sulfide to a list of chemicals whose releases must be reported annually under the Toxics Release Inventory program.

The chemical was among 82 nominated for listing in a petition submitted in 1992 by then-New York Gov. Mario Cuomo and the Natural Resources Defense Council. After it accepted the petition and announced its intentions, the EPA received a torrent of letters, many of which focused on hydrogen sulfide and a related compound, methyl mercaptan, added to natural gas to give it a detectable odor.

The Chemical Manufacturers Association insisted that there had not been a "sufficient demonstration of hydrogen sulfide's chronic effects."

The American Forest and Paper Association said that there was "no scientific rationale for listing either hydrogen sulfide or methyl mercaptan."

The EPA scientists held their ground. One internal memorandum advised the agency to "continue support for (hydrogen sulfide's) chronic neurotoxicity effects."

But in the end, hydrogen sulfide and methyl mercaptan were culled from Cuomo's list. Any action on them was put on hold under what the EPA calls an administrative stay. The reason was explained with unusual candor by Assistant EPA Administrator Lynn Goldman in the Aug. 22, 1994, Federal Register:

"The Chemical Manufacturers Association and the American Forest and Paper Association have told the agency that unless administrative action is taken to resolve the issues outlined in today's document, a prompt legal challenge will be brought."

Susan Hazen, director of the EPA's Environmental Assistance Division in Washington, said the administrative stay on hydrogen sulfide may be lifted by the end of the year and the substance "may well meet the listing criteria on chronic neurotoxicity."

Earlier this year, however, oil and gas companies dodged yet another bullet. When the EPA brought seven broad industry sectors under the Toxics Release Inventory program, one was conspicuously absent: oil and gas exploration and production.

One who has argued for inclusion of this industry is Robert Wages, president of the Oil, Chemical and Atomic Workers union in Denver. In a letter to EPA Administrator Carol Browner on May 30, 1996, Wages wrote that oil and gas operations release "vast quantities"

of toxic chemicals.

He singled out gas processing plants, "which are mostly made up of old, surplus equipment" and leak "substantial, unreported volumes of hydrogen sulfide."

The EPA's position is that the industry is so idiosyncratic and diffuse that it is difficult to bring under any sort of regulatory program. "It isn't neat and tidy," said the agency's Hazen, who emphasized that the matter is still under evaluation.

Chris Shuey, an oil and gas specialist with the Southwest Research and Information Center in Albuquerque, sees no need for further study.

"The oil and gas industry made all these outrageous claims that if they were to be included in (the inventory), it would cost them $200 million and put people out of work," Shuey said. "They claimed that all of their sites are in remote areas, well away from people. For us, those kinds of statements don't pass the laugh test.

"The industry's claims are spurious, but you would expect that," he said. "What I don't expect is this continued penchant of certain EPA administrators to simply cave in. It's a little bit tiresome that people in Washington seem to cower at the big, bad oil and gas industry."

The industry's clout is well-documented. Oil and gas producers and marketers contributed nearly $9 million to congressional candidates -- most of them Republican -- in the 1994 elections, according to the Center for Responsive Politics in Washington, and gas distributors gave another $2.5 million.

The EPA isn't the only federal agency to capitulate to these interests.

On May 10, 1988, the National Transportation Safety Board recommended to the U.S. Department of Transportation that it establish a maximum allowable hydrogen sulfide concentration for natural gas in pipelines; that pipeline operators be required to install detection and shutoff equipment that would respond automatically when maximum levels were exceeded; and that such incidents be reported.

The NTSB didn't pull this proposal out of thin air. There had been several disturbing pipeline incidents, including one near Winters, Texas, on Aug. 12, 1987. A gas stream feeding a Lone Star Gas plant was found to contain 1,600 parts per million of hydrogen sulfide -- several times the lethal dose.

Residents were safely evacuated, but it was learned that an automatic shutoff valve programmed to close the pipeline when hydrogen sulfide levels exceeded 6 ppm had failed. Lone Star told the NTSB that it had had 11 other incidents involving excess hydrogen sulfide levels in its pipelines since 1977.

On June 7, 1989, the Transportation Department accepted the NTSB's recommendations and published an "advance notice of proposed rulemaking." Like the EPA, it was quickly inundated with letters.

The consensus among companies such as Texaco, Phillips, Chevron, Tenneco and Lone Star was that the regulations were unnecessary and would be prohibitively expensive. On March 7,

1996, the Transportation Department formally abandoned the idea, much to the annoyance of the NTSB.

The case for an EPA crackdown on hydrogen sulfide was made at a hearing before the Senate Committee on Environment and Public Works on June 19, 1987. The two witnesses that day were from North Dakota, home of the late Sen. Quentin Burdick, then chairman of the committee.

John Brophy of the Fargo-Moorhead Audubon Society and John Lamb with the Dacotah Chapter of the Sierra Club testified that hydrogen sulfide releases from oil and gas wells in the western part of the state had killed cattle and caused the evacuation and hospitalization of people.

They pleaded for federal intervention. It never came.

Dr. Harriet Ammann joined the EPA's science staff in North Carolina in 1984 and was immediately handed the task of researching hydrogen sulfide. She did so, off and on, for the next six years, authoring a detailed health-assessment document on the chemical before leaving the agency in 1990.

Now a senior toxicologist with the Washington Department of Health in Olympia, Ammann is convinced that an important opportunity was missed when hydrogen sulfide was bumped from the Hazardous Air Pollutant list.

"I don't know why it was removed," she said recently. "We were working on risks to the general public, and the public is exposed to it in areas where there are facilities that produce it.

"It's clearly known, from industrial exposures, that it's a very toxic gas," Ammann said. "It hasn't gotten a lot of respect, in a sense, because everyone's smelled it and made jokes about it. But there's no one who could stand even 20 parts per million of it. I have encountered it in a number of different situations in this state."

The EPA list that exists today took shape in 1988, when then-Sen. George Mitchell, D-Maine, submitted the names of 224 chemicals derived from three EPA databases.

The EPA to this point had developed standards for only eight compounds: asbestos, mercury, beryllium, vinyl chloride, benzene, inorganic arsenic, coke oven emissions and radionuclides. Its air-toxics program was, by any measure, a bust.

Hydrogen sulfide was included on the Mitchell list, according to an internal EPA document, because of its high toxicity. The list was trimmed to 191 during the first half of 1990, and hydrogen sulfide survived the cut.

By the time the final bill got to the White House in November, only two of the 191 chemicals had been targeted for removal: hydrogen sulfide and, in a concession to agriculture, ammonia.

A former congressional aide involved in the negotiations said that the inclusion of hydrogen sulfide on the list "became a lightning rod. API (the American Petroleum Institute, the major oil companies' trade association) was all over it. Our preference would have been that it

stayed on the list."

A senior API attorney explained the oil industry's position. "What it really came down to was that hydrogen sulfide emissions are not appropriately handled as routine emissions," Ellen Siegler said. "Our view was that this was more of an accidental-release issue."

Told that the chemical is, in fact, regularly discharged in large quantities at a number of locations, Siegler said: "That's news to me."

U.S. Rep. Henry Waxman, D-Calif., one of the architects of the 1990 act, said that there was uncertainty at that time about hydrogen sulfide's behavior at low levels.

"There have since been some studies showing that low-level exposure does present a public-health threat," Waxman said. "I'm concerned about it."

It is fair to say that less was known seven years ago about hydrogen sulfide's more subtle actions on the human body than is known today.

But even in 1990 there were clues.

A 1964 U.S. Public Health Service report on an outbreak of nausea, vomiting, diarrhea and shortness of breath in Terre Haute, Ind., for example, identified as the culprit a "vile odor" -- discovered to be hydrogen sulfide -- from an industrial waste lagoon.

"Certainly nausea is more than merely a nuisance since it interferes with physical comfort, appetite and general well-being," the report's authors wrote. "People do not have to die to prove that a medical or public health problem exists."

As it happened, a clerical error allowed hydrogen sulfide to remain on the Hazardous Air Pollutant list for a year after Bush signed the act. It took a joint resolution of Congress -- Waxman made the motion in the House -- to get it off for good.

The final list of 189 has since been reduced by one. Caprolactam, a feedstock used in the making of nylon, was removed by the EPA in response to an industry petition.

There is nothing in the law that precludes the agency from adding a chemical to the list; the administrator can do so independently, without a petition, in the face of persuasive new evidence.

"Even if you come to the conclusion that Congress made a mistake," said David Hawkins, a senior attorney with the Natural Resources Defense Council, "that mistake doesn't have to be a permanent one."

THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

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Locales differ, but similar tales of frustration heard

By JIM MORRIS

PLEASANT HILL, Ark. -- Vanquished after two years of resistance, Lisa White was moving out.

The night before, White had attended yet another fruitless meeting about a sour gas processing plant that lay just west of her home and had made life miserable for her and her two sons. She'd come away fuming and dejected.

"I've given up," she said. "I don't even want to be here anymore."

White reluctantly would send her boys, 17-year-old Dusty and 11-year-old Billy, to live with their grandparents in Texarkana, 10 miles north of this unincorporated community in the piney woods of southwestern Arkansas. She'd go back to her cross-country trucking job and visit them as often as she could.

White had challenged a small segment of the oil and gas industry and lost, learning a hard lesson in the process: It is nearly impossible to stop or curtail development of this sort, even with evidence of chronic disease or life-threatening neglect.

It is a lesson that also has been learned in Manistee, Mich., Artesia, N.M., and other out-of-the-way places where the economics of energy can overshadow public health.

"The oil and gas guys are very powerful," said Hugh Kaufman, an engineer in the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response in Washington. "They've got a lot of money to throw around."

By and large, the 300 or so residents of Pleasant Hill came to the hills of central Miller County in search of sanctuary. To them, even Texarkana was too dirty and chaotic; they wanted to be in the country, where they could raise their children and their animals with minimal disruption.

Chaos found them anyway, in the form of a gas "sweetening" plant and five adjoining oil wells that routinely give off stomach-turning odors and occasionally disgorge poisonous clouds. A large paper mill just across the state line in Texas adds to the putrescent mix.

"We feel like all the sour gas in the world is coming through here," said Pat Rodgers, who had a hydrogen sulfide monitor in her yard from January 1995 until April of this year. The monitor regularly displayed readings of 50 parts per billion -- 10 times the widely recognized odor threshold and two to five times the statutory limit in several states. (Arkansas has no limit.)

A more sophisticated monitor on Bill and Ann Grey's ranch recorded hydrogen sulfide levels in excess of 100 ppb on numerous occasions last summer.

"We've had mornings where we tried to gather the cows up and our eyes got to watering so bad we had to quit," Bill Grey said.

In July 1996, the Arkansas attorney general's office took the unusual step of suing the gas plant owner, Warren Energy Resources (a subsidiary of Houston-based NGC Corp.), and the well operator, Harleton Oil and Gas of Tyler, on the grounds that their emissions of hydrogen sulfide and sulfur dioxide constitute a public nuisance.

International Paper, owner of the mill in Texarkana, Texas, recently was added as a defendant.

The lawsuit alleges that the sour-gas pollution has afflicted the people of Pleasant Hill with headaches, nausea, dizziness, burning eyes and shortness of breath. As a result of the noxious odors, it says, "many of the residents have been and continue to be unable to use their property for work and enjoyment."

The attorney general is seeking a permanent injunction that would force the companies to stop the offensive releases. The case is so politically sensitive that four judges begged off before one was found to preside.

"I've never gone through four judges before," said Assistant Attorney General Charles Moulton, the lead prosecutor.

At first, Lisa White and the others in Pleasant Hill were heartened by the attorney general's action: Perhaps the three companies finally would be held accountable for incidents such as the May 8, 1996, explosion at Warren, which terrified and sickened dozens of people, including young Dusty White.

As the months wore on, however, their optimism faded.

It became obvious that, although one arm of the Arkansas government had declared the Warren plant a nuisance, another -- the state Department of Pollution Control and Ecology (PC&E) -- was inclined to let it double its production of sulfur, from about 36,000 pounds per day to about 72,000 pounds.

Warren promised PC&E that it could accomplish this without increasing the amount of sour gas it brings into the plant. Indeed, it promised reductions in hydrogen sulfide and sulfur dioxide emissions, thanks to pollution-control upgrades.

The people of Pleasant Hill were incredulous. At a meeting with PC&E officials in Texarkana on July 2, they voiced their exasperation.

"We've given up using the word `smells,' " said Gerald Adcock, a tall, white-haired man of 71 who has lived in Pleasant Hill since 1936. "It's a health hazard. Why do they bring this (sour gas) out of the ground? Because it's a money-making deal. They're shoving something down our throats that's a money-making deal."

Members of the audience were told that there was virtually nothing they could do to influence the department's decision on Warren's sulfur proposal. Although the state and the EPA have come to terms on an elaborate air-monitoring program for Pleasant Hill, Warren's permit application apparently cannot, by law, be held up pending the results.

"We want to help you," said PC&E's Barbara Davis, who moderated the discussion, which, at one point, nearly propagated a fistfight between a Warren employee and a plant critic. "No one's trying to talk down to you. I know you are frustrated. Our director knows you are frustrated. Our commission knows you are frustrated."

At first, Warren wanted to capitalize on a sour gas boom in East Texas by building a second processing plant in Miller County. Dogged opposition from Pleasant Hill residents -- notably, a woman named Barbara Willis -- convinced the company to offer an alternative: a 100 percent increase in sulfur production at the existing plant, which opened in 1990.

Willis was among those who denounced the idea at the July 2 meeting, saying, "To me, this is not a trade-off. It's a health issue we need to seriously look at."

PC&E chief legal counsel Steve Weaver said in an interview, however, that "from the department's point of view, this was a pretty good deal. We were having not two sour-gas plants but one, and getting better pollution-control efficiency."

In order to deny Warren's permit application, Weaver said, the department would need a clear indication that the plant is a significant contributor to the distress in Pleasant Hill.

Asked about the attorney general's lawsuit, which suggests that Warren *is* a problem, Weaver said: "We're two separate agencies. We have litigated against the attorney general before on regulatory matters and won."

As it stands, there are three suspects in the Pleasant Hill inquiry: Warren, Harleton and International Paper.

International Paper spokesman Kirk Clayborn said that the company was "quite surprised by our inclusion in this suit," given that it has reduced odors by more than 75 percent since 1990 and complies with all state and federal standards.

"I think it's just a shotgun approach," said Harleton President Bruce Wooldridge. "They just named everybody that's in the area."

Dean Ayers, NGC's vice president for investor relations, declined comment on the Warren plant.

PC&E is still mulling the Warren matter and may reach a decision by the end of the year. A few months ago, the department was handed an even taller order by the Arkansas legislature: develop a statewide ambient air standard for hydrogen sulfide.

Residents of Pleasant Hill are not hopeful about either endeavor.

"We're fighting money and politics," said Pat Ray, who became violently ill early one morning after driving through what she believed to be a patch of sour gas.

Said Pat Rodgers: "Three or four years ago, I didn't even know about hydrogen sulfide. Now, it's taken over my life. You can't go to bed at night with any peace of mind."

Turmoil in Michigan

A thousand miles northeast of Pleasant Hill, people in Michigan's Manistee and Mason counties are understandably edgy about drilling in the prolific Niagaran Reef.

The area has had at least 11 sour gas releases since 1993 and 16 since 1980, according to research by Manistee resident Dana Schindler and the Michigan Land Use Institute in Benzonia. Evacuations took place and illnesses were reported in almost every case.

"Many of the H2S releases ... never were officially recorded or thoroughly reviewed by either the oil and gas industry or state regulators," institute director Keith Schneider wrote in a recent newsletter. "They represent a significant public health problem that essentially has been ignored by state authorities."

Filer Township, which lies just south of the lakefront city of Manistee, is pressing a public-nuisance lawsuit against two independent oil and gas exploration companies. In effect, the township has given up on the Michigan Department of Environmental Quality, which is supposed to regulate such operations, and turned to the judicial system for relief.

Both defendants have inactive sour wells in populated areas. One well, which has an estimated hydrogen sulfide content of 43,000 parts per million, was shut in but not permanently plugged by Manistee Gas Limited Liability Co. of Wyoming.

There is confusion about the current ownership of the so-called Della Pia 1-22 well, and a sign posted on the chain-link fence that surrounds it is not reassuring. "In case of emergency," it reads, "dial 616- ." The final seven digits are missing.

"We want it plugged, and we don't want it reopened -- ever," said Jim Olson, an attorney in Traverse City who is representing the township.

The other well, with a hydrogen sulfide concentration of 1,400 ppm, has been plugged by Aztec Producing Co. of Traverse City, but there are concerns about its stability.

Carl Mikolajczak lives about 800 feet north of the Aztec 1-23 well and runs an excavating business from a nearby shop.

At about 2 p.m. on Jan. 27, Mikolajczak was struck by a wave of nausea as he approached his shop. "Before I even got close to it, I could smell this strong odor," he said. His head began to pound and his face flushed.

The odor was still overpowering when Mikolajczak arrived home a few minutes later. His wife, Delphine, already had evacuated; his dog had vomited in the breezeway. The Mikolajczak's grown son, Eric, also became ill.

There is no doubt in Carl Mikolajczak's mind that sour gas leaked from the 1-23 well, then being drilled.

"What they're doing in a populated area is totally uncalled for," he said. "What they're telling us is, `The heck with you, as long as we get the oil out of the ground, that's all that matters.' Their dollars are more important than my life."

Aztec's attorney, Kurt Bowden, said in a prepared statement that although the company's drilling contractor noticed no problems among its workers on Jan. 27, it "cannot categorically deny that there was any release."

The contractor apparently complied with all state requirements, Bowden said, adding that attempts by Filer Township and others to assume greater control over oil and gas operations "will do nothing but create a hodgepodge of conflicting local regulations which will render it impossible for a producer to do business in Michigan."

Two top Filer Township officials say that they are well within their purview, given the stakes. Fire Chief Ron Gutowski and Supervisor Jim Espvik shudder at the thought of a massive hydrogen sulfide release, guessing that the little community could not muster an effective emergency response.

"It's a nightmare," Espvik said.

Attorney Olson said that Michigan is experiencing a "regulatory crisis" with regard to hydrogen sulfide. Circuit Judge James Batzer, presiding in the township's nuisance case, seemed to agree during an April 28 hearing on an Aztec motion to dismiss, saying he was "amazed ... flabbergasted and astonished" at the state's apparent nonchalance.

The DEQ "has not addressed the health, safety and welfare issue," Batzer said. "This court is prepared under the law of nuisance to shut down any and all sour gas wells in this circuit, if necessary, to assure public safety."

DEQ spokesman Ken Silfven said that while the department had not been ignoring the sour gas issue, an August 1996 well release in Manistee that sent 11 people to the hospital brought to light certain regulatory weaknesses.

Since the accident, Silfven said, the DEQ has taken steps to improve its oversight of the oil and gas industry. In June, it ordered operators to burn any excess hydrogen sulfide rather than simply vent it.

The DEQ has held training sessions with local 911 operators who might have to field complaints about gas leaks and broached the idea of joint training exercises with the Michigan Fire Chiefs Association. The state Department of Community Health has agreed to assess victims of any future releases.

"This is really something that the (DEQ) is paying attention to," Silfven said. "It's not just talk on our part."

The fracas of the moment in northwestern Michigan involves the proposed 43-mile extension of a 26-mile sour-gas pipeline. If certified as a "public necessity" by state officials, the 69-mile line would pass through three counties -- Oceana, Mason and Manistee -- and carry gas laced with 20,000 ppm of hydrogen sulfide.

Two public hearings have been held on the proposal thus far; in both cases the operator, Basin Pipeline, and regulators got an earful.

Jim Skifstad, a professor of mechanical engineering at Purdue University and a summer resident of Manistee, has condemned in many forums the state's "unbelievably lax" sour gas pipeline-safety regulations and Republican Gov. John Engler's aggressively pro-business policies.

"The laws in our state have been written by the gas industry," he said. "These people have been running wild."

Michigan Oil and Gas Association director Frank Mortl rebutted this charge, saying in a prepared statement that the industry makes "every effort to prevent the release of any hydrogen sulfide gas during our operations."

Engler's spokeswoman, Pat Masserant, said that the governor has asked the Michigan Environmental Science Board to review the state's oil and gas regulations on a scientific basis rather than an emotional one in light of the strong feelings on both sides of the issue.

Shouted down in Artesia

Divina and Robert Duncan are glaringly overmatched in their campaign against Navajo Refining Co., whose refinery looms above the small buildings in downtown Artesia, N.M.

The Duncans, who live due north of the refinery, say that it frequently unleashes sulfurous odors that cause headaches, nausea and dizziness.

"I was raised on a hog farm, and it was never like this," Divina Duncan said.

"The stench gets so bad that you don't even want to take a breath," her husband said.

Divina Duncan and her daughter, Jackie Box, were taunted when they spoke out against Navajo at a public hearing in Artesia last March.

The meeting room was jammed with refinery workers and other boosters; three days earlier, the Greater Artesia Chamber of Commerce had exalted the refinery in a full-page advertisement in the local newspaper.

The ad's headline: "Imagine Artesia without Navajo."

From 1991 to 1995, Andy Nowak inspected the refinery for the New Mexico Environment Department. "I had lots of trouble with them," he said.

Two years ago, Nowak became a permit engineer for the department. One of his first assignments was to review Navajo's request to modify a unit in Artesia.

"I wanted to write a tight permit," Nowak said, forcing Navajo to correct what he believed to be unsatisfactory flaring of hydrogen sulfide.

"Boy, did they howl," he said of Navajo. "They howled all the way to the top."

On Feb. 8, 1996, Nowak and three colleagues sent a memorandum to two of their supervisors, recommending that a public hearing on Navajo be held in Artesia.

Without such a hearing, the memo's authors warned, "we may be doing the community a disservice and risking accusations of indifference." The refinery, they noted, "has been a consistent violator of air quality regulations."

Nowak was reprimanded and taken off the Navajo case. He lodged a whistleblower complaint with the U.S. Department of Labor, got a favorable decision and settled with his bosses in February.

One condition was that Nowak keep his job; another was that the hearing in Artesia go forward.

It did, on March 19. Nowak was there to watch Divina Duncan and Jackie Box be ridiculed.

"The refinery packed it with 300 of their family members," Nowak said. "It was a circus. They took total control of the meeting, and the state let them do it."

Navajo spokesman Bill Gray said that while the refinery's capacity has nearly quadrupled since the late 1960s, emissions are down considerably.

"I think we're excellent corporate citizens," said Gray, who referred to the refinery's critics as "soreheads."

The Duncans, he speculated, are angry because Navajo will not buy them out.

As recently as Sept. 15, however, the state cited Navajo for 10 alleged violations, including inadequate monitoring of hydrogen sulfide levels in its fuel gas.

"They just drag their feet on anything to do with environmental compliance," Nowak said.

THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

H_2S exposures

Hydrogen sulfide exposures treated at poison control centers have nearly tripled since the late 1980s.

Year	Cases	Deaths	Centers reporting
1987	480	1	63
1988	531	7	64
1989	769	4	70
1990	688	1	72
1991	897	5	73
1992	123	0	68
1993	1144	2	64
1994	1411	9	65
1995	1407	0	67

Source: American Association of Poison Control Centers

Chronicle

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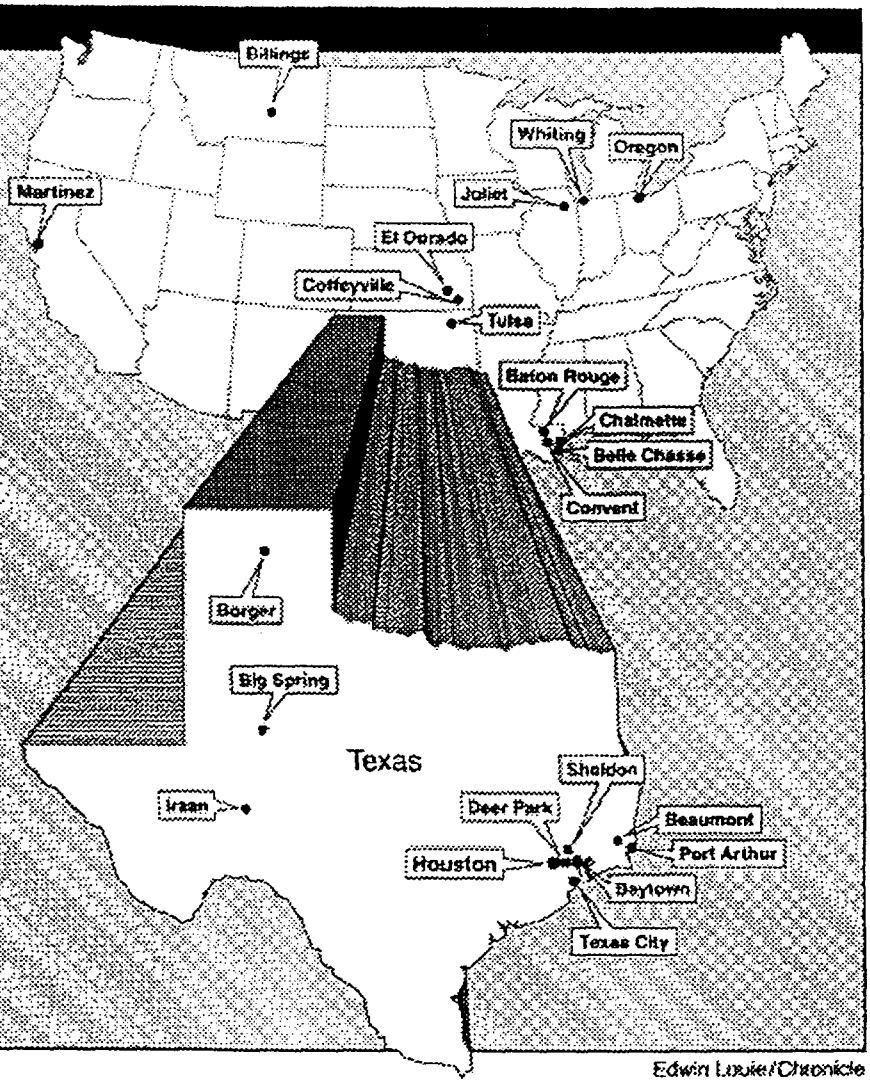
Hard-hit cities

Each of these cities had at least 15 hydrogen sulfide releases from 1987 through mid-1997. The figures are derived from reports by companies to the Environmental Protection Agency's Emergency Response Notification System.

City	Number of releases
Borger	308
Houston	130
Port Arthur	105
Coffeyville, Kan.	67
Texas City	63
Baton Rouge, La.	56
Baytown	39
Iraan	39
Belle Chasse, La.	35
Big Spring	30
Deer Park	27
Chalmette, La.	24
Convent, La.	24
Martinez, Calif.	24
Billings, Mont.	20
Beaumont	18
Sheldon	18
Whiting, Ind.	18
Oregon, Ohio	17
Tulsa, Okla.	17
El Dorado, Kan.	16
Joliet, Ill.	16



Edwin Lozier/Chronicle

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A sickening experience in the Kazakhstan oil fields

H2S exposure leaves engineer with severe debilitating illnesses

By JIM MORRIS

Gabe Sugar is into yoga and organic foods with an enthusiasm that borders on obsession.

He is a recent, and desperate, convert.

Sugar's aim, he explained in his small Houston apartment, is to rid his body of the poison -- hydrogen sulfide -- that ravaged him while he was working in the former Soviet republic of Kazakhstan four years ago. He has lost faith in traditional medicine, which proved unable to cure his headaches, his sleeplessness, his joint pain, his fatigue.

"Using natural techniques, I can get the gas from my system," Sugar, a 51-year-old chemical engineer, said between handfuls of roasted soybeans. "It cleans you. I believe the worst part is over."

The saga of Gabor "Gabe" Sugar, a Hungarian-born American citizen, began in September 1993, when he was hired by Bechtel Corp. and sent to the Tengiz oil field on the northeastern shore of the Caspian Sea. Bechtel had contracted with the principal American developer of the field, Chevron, to oversee construction of an oil and gas processing plant.

The job, Sugar knew, was not cushy. Kazakhstan is brutally hot and bug-infested in the summer and brutally cold in the winter, and Tengiz is notorious for its high H2S concentrations. (Experts determined that a 1985 well blowout had the potential, according to the Russian newspaper Izvestia, to "poison every living thing within hundreds of kilometers.")

Still, Sugar, a widower with two children, felt that he had no choice. The money was appealing, and he'd been around toxic chemicals before without incident. How bad could it be?

Very bad, as it turned out. Apart from the austere accommodations and the vile food, there was the constant threat of exposure to hydrogen sulfide, whose rotten-egg odor permeated the site.

"My friends said, `You're crazy. Don't go,' " Sugar recalled. "I said, `I'm a U.S. citizen. I'm working for a big company.' I was just naive."

Indeed, in the mid-1980s -- years before Bechtel and Chevron sent Americans to Tengiz -- the field was replete with Hungarian construction workers who toiled under gulag-like conditions.

The chilling stories told by the Hungarians when they returned home became the basis for a 1990 book by journalist Kata Réz, titled *Hungarians in the Death Zone*.

In the book, Réz discusses what she calls "Tengiz Syndrome" -- a debilitating form of hydrogen sulfide poisoning. She quotes Dr. Mózsa Szabolcs, a physician who examined a number of sick workers, as saying that "symptoms of the mucous membranes, the respiratory tracts, the eyes and the intestinal tracts and anomalies of the nervous system point to the presence of low-concentration gas as the real cause" of the illnesses.

The Hungarian government had refused to acknowledge these conditions as being work-related. Szabolcs observed that "doctors who are not familiar with the effects of low-concentration hydrogen sulfides and mercaptans (a related family of substances) are befuddled by the incoherent symptoms and think of a great variety of internal pathologies."

The breakup of the Soviet Union in December 1991 cleared the way for American investment. In April 1993, Chevron and the newly independent republic of Kazakhstan formed a partnership known as Tengizchevroil to extract and process the estimated 6 billion to 9 billion barrels of oil in the Tengiz field. (Mobil also had a stake.)

Sugar was notified of his hiring by Bechtel on Sept. 7, 1993. He would be a project engineer, earning a base salary of $1,038 per week.

Sugar put his son, Martin, in a German boarding school and sent his daughter, Julie, to live with friends. He left Houston for Kazakhstan on Sept. 19, stopping for a day in London to receive what he later described as cursory hydrogen sulfide safety training by a Bechtel consultant.

Sugar said that he became ill almost immediately upon his arrival at Tengiz but ascribed his malaise to jet lag and immunizations he had been given in London. During the last few months of 1993 and the first few months of 1994, he said, he rarely felt well.

The nadir came on March 2, 1994, when, Sugar maintains, he experienced a "knockdown" -- a loss of consciousness caused by a large dose of H2S. He spent three days in the Tengizchevroil infirmary, complaining of weakness, dizziness and abdominal pain.

"I was vomiting blood, had blood in my stool," Sugar said. "I had the feeling that, really, I am dying."

Both Bechtel and Chevron -- which last summer settled a lawsuit filed against them by Sugar -- denied in court documents that hydrogen sulfide played a role in Sugar's illness or that he was fired for reporting a potentially serious design flaw.

In a declaration signed Dec. 12, 1994, the medical director for Tengizchevroil, Dr. William Chapman, stated that Sugar was suffering from a long-standing ulcer and that "at no time did (he) come to the clinic for injury or disease related to exposure to H2S."

Chapman added, however, that "after exhaustive searching of medical files at the clinic," none of Sugar's records from March of 1994 could be found.

(Dr. Arch Carson, an occupational medicine specialist at the University of Texas Health Science Center in Houston who treats Sugar, gives "noxious vapor inhalation injury" as his primary diagnosis.)

In a speech to the World Affairs Council of Orange County (Calif.) on Aug. 9, 1994, Chevron vice president Espy Price characterized Tengiz as a "geologist's dream but a petroleum engineer's nightmare."

"The field is deep -- two to three miles down -- and it's hot down there and under extreme pressure," Price said. "So the wells cost a lot to drill and the wellheads have to be big, strong and elaborate.

"Tengiz holds not just oil, but a lot of natural gas as well. The oil and gas come out of the ground together, and the gas is laced with toxic hydrogen sulfide, which can be deadly if you don't contain it."

Sugar's main safety concern -- to which Bechtel never responded, he said -- pertained to two desulfurization units known as KTL-1 and KTL-2. The purpose of such units, as the name implies, is to remove sulfur compounds from the oil-gas mixture prior to shipment.

When Sugar arrived in Kazakhstan, KTL-1 already was up and running; KTL-2 was under construction and behind schedule. Under considerable pressure from Chevron, Sugar said, Bechtel proposed an engineering shortcut he feared would overload KTL-1 and lead to a major hydrogen sulfide release.

After pressing his concern with Bechtel management, Sugar was reassigned in April 1994. He returned to Houston -- quite ill, he said -- and was placed on nebulous, unpaid "holding status" by Bechtel until January 1995, when he was officially fired. He has worked infrequently since then.

Jeff Berger, a spokesman for Bechtel at its San Francisco headquarters, said that Sugar's claims are "totally without merit, pure and simple. We settled that case on a nuisance basis to avoid the cost of litigation."

Berger said that the company's internal investigation indicated that Sugar was not sickened by hydrogen sulfide. "There was no problem," Berger said. "There is no problem."

Both Bechtel and Chevron had extensive measures in place at Tengiz to protect employees from H2S, Berger said.

"We don't have a second-tier safety program that we pull out of our coat when we're working in a developing country," he said. "We aim high all over the world."

In a prepared statement, San Francisco-based Chevron said that Sugar was "one of thousands of workers at Tengiz at that time, and the only one to make allegations of this nature. We settled the case short of a trial basically to avoid the cost of litigation."

The company added: "Everywhere we operate in the world, including Tengiz, we apply the same health and safety standards as we do in the United States."

In a deposition taken on Aug. 26, 1996, however, Dr. Pal Bukkerdo, a Hungarian physician who worked at Tengiz, testified that he knew of 30 to 40 instances between 1990 and 1994 "where there was leakage of hydrogen sulfides and there was an alarm ordered because of

that."

As of early 1994, the on-site laboratory was not equipped to determine whether a worker had been exposed to the gas, Bukkerdo said. And some Bechtel workers, he testified, were not provided H2S monitors.

Sugar cannot reveal the terms of his settlement with Bechtel and Chevron. He did say that he is experiencing financial difficulties -- in large part because two insurance companies are squabbling among themselves and refuse to pay his medical bills.

"I would be happy if I could put this behind me, but I can't," Sugar said. "I am still not receiving any benefits."

His attorney, Robert M. Rosenberg, said that Sugar's protracted state of limbo has been particularly trying for his children, 20-year-old Martin and 13-year-old Julie, who lost their mother in 1989.

"Watching their father decline, worrying about his health -- if he dies, what's going to happen -- it's just a tragedy to me," Rosenberg said.

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BRIMSTONE TEAM:

Special projects reporter: Jim Morris

Photographer: Smiley N. Pool

Projects editor: Don Mason

Coordinating editor: Paul A. McGrath

Designer: Kellye B. Sanford

Photography editor: Dave Einsel

Art Director: Ernie Williamson

Electronic imagers: David Foltyn and Pattie Harrington

Interactive design: Marla Cloud

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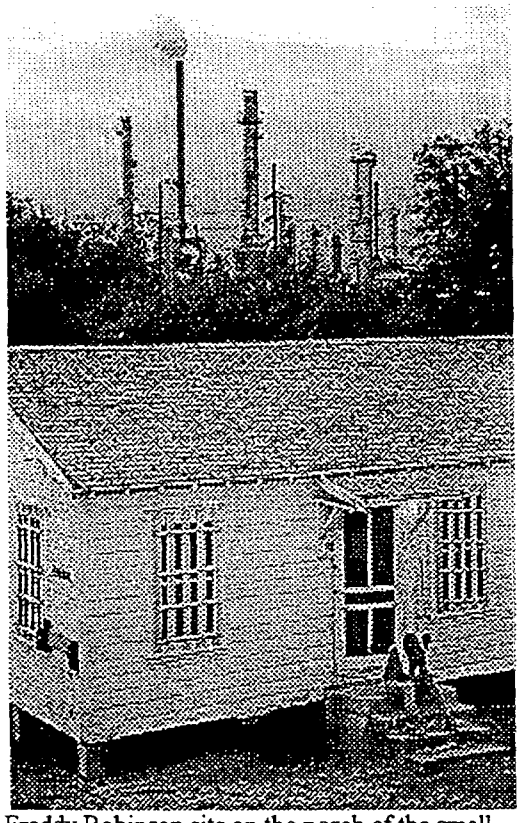
Fouled air creates ire; enforcement labeled ineffective

By JIM MORRIS



Freddy Robinson sits on the porch of the small home he rents in the shadow of Corpus Christi's Koch refinery. Residents are calling ofr an industry buyout and a buffer zone around the plants.

At 5:13 p.m. on June 18, the Corpus Christi Fire Department's Engine 12 was dispatched to a neighborhood near that city's "Refinery Row," a 10-mile industrial strip northwest of downtown.

A resident had called and complained of intense nausea, blaming it on an unidentifiable odor he assumed had come from one of the plants.

For Refinery Row, this was nothing new. The mostly poor people who are effectively stuck in the area had complained for years about repugnant odors, not to mention brilliant, smoking flares and ear-splitting noises.

As Engine 12 arrived on the scene this sultry June afternoon, however, the gravity of the situation quickly became apparent. The crew encountered what was later described as a "strong sulfur and rotten egg" odor and asked that other units be brought in to help locate the source.

When Engine 9 passed by the Citgo West refinery about 45 minutes later, two firefighters suffered burning eyes and throats.

Nearby, two investigators with the Texas Natural Resource Conservation Commission felt queasy as they sampled for the suspect chemical: hydrogen sulfide. The readings displayed on their hand-held analyzer at the refinery fence reached 2.1 parts per million, more than 17 times the state limit (.12 ppm, averaged over 30 minutes) for industrial areas.

Citgo was cited by the TNRCC for creating a nuisance. Fire Department officials were perturbed, not only because two firefighters got sick but also because Citgo was slow to confirm that there had been a release.

"The Citgo incident caused us a lot of concern," said Fire Chief J.J. Adame. "The information was not flowing the way we like it to."

The events of June 18 came as no surprise to the people of Refinery Row. To them, the only

remarkable thing is that Citgo was caught.

"They (the plants) never tell you nothing," said Alfred Williams, who has lived in Mobile Home Estates since 1972. "Sometimes you have to turn the air conditioner off because it sucks in that bad air, just pulls that rotten-egg scent into your house."

Company spokesman Chuck Cazales said that the June 18 release from Citgo West occurred after a bird flew into an off-site transformer, disabling emission-control equipment at the refinery.

"It was kind of an act of God," he said.

Hydrogen sulfide (H2S) would pose a sizable public-health problem in Texas even if it were confined to Refinery Row, where an estimated 20,000 people are routinely exposed to it.

In fact, a Houston Chronicle investigation has found that the problem is much bigger. People in many parts of the state -- from the industrial neighborhoods of Pasadena, Beaumont-Port Arthur and Odessa to rural East Texas and the Panhandle -- have gotten little relief from a substance that is at best bothersome and at worst deadly.

In 1995, according to company estimates filed with the TNRCC, nearly 10 million pounds of hydrogen sulfide were legally released by refineries, paper mills and other industrial plants in the state.

One plant alone, the Sid Richardson Carbon Co. in Big Spring, put out 1.8 million pounds, although in a relatively remote area. (On April 3, 1996, technicians in the TNRCC's mobile air-monitoring laboratory noted "very intense H2S odors" outside Sid Richardson -- which produces carbon black, used in tires and other products -- and the nearby Fina refinery).

In the Houston area, the Marathon Oil refinery in Texas City emitted 900,000 pounds of hydrogen sulfide, the Simpson Pasadena paper mill in Pasadena 244,000 pounds and the Champion International paper mill in Sheldon 236,000 pounds.

These routine emissions, allowed through a combination of state permits, exemptions and grandfather clauses, do not include accidental releases, euphemistically known as "upsets."

From 1984 through 1996, according to company estimates reported to the TNRCC, nearly 2 million pounds of hydrogen sulfide were discharged in this fashion.

For some communities, the complete picture -- an almost-constant, low-grade insult to the sinuses and lungs, punctuated by moments of sheer terror -- is profoundly depressing. In many cases the victims blame the TNRCC -- which regulates the state's major sources of air toxics -- as much as the polluters for their predicament.

"I don't think they're hearing us," said Gladys Gillord, who has lived in Beaumont's Charlton-Pollard neighborhood since 1965.

"The TNRCC has done a miserable job of making themselves available to the neighborhood," said the Rev. Roy Malveaux, pastor of Mount Zion Baptist Church in Beaumont and state director of People Against Contaminated Environments (PACE).

Charlton-Pollard borders several large sources of hydrogen sulfide, including the Mobil refinery and the Elf Atochem petrochemical plant. Gillord said that she has had three unnerving brushes with the gas in the past four years.

A release in early 1993 "almost killed me," said Gillord, 61, who has a heart condition and whose 69-year-old husband is blind and bed-ridden. "One morning I got up and it was real cold, misting rain. I went outside to the garbage can and I couldn't hardly get back in the house.

"The odor was very familiar. It smelled like rotten eggs. And, honey, my face was so numb and I couldn't breathe. My mouth was sour for three days -- just sour, sour, sour, like I was sucking lemons."

To be sure, the TNRCC faces a demanding task. A ground-hugging cloud of hydrogen sulfide can follow a wildly unpredictable course and disperse rapidly. Where it settles, it can sicken and even kill.

Violations of the state's hydrogen sulfide standard for residential areas (.08 ppm) were documented by the TNRCC's mobile lab in February near the Valero and Citgo East and West refineries in Corpus Christi.

The Clark refinery in Port Arthur exceeded the standard in October 1996. Things got so bad at that city's Fina refinery several years ago -- some residents of the Fairlea Addition had to be hospitalized after a hydrogen sulfide release in the spring of 1991 -- that Attorney General Dan Morales brought a civil action against the company.

The lawsuit, alleging 25 violations of the Texas Clean Air Act between 1988 and 1993, was settled last year. Fina agreed to pay a $509,000 fine and build a second sulfur-recovery unit to curb the emissions.

In the Houston area, the Exxon refinery in Baytown reported 31 major hydrogen sulfide upsets from 1984 through 1996 and the Lyondell-Citgo refinery in Houston 13, according to state records.

An upset at Lyondell-Citgo last winter demonstrated the potential consequences of equipment failure: When the refinery's sulfur-recovery unit went down on Jan. 21, an estimated 5,277 pounds of hydrogen sulfide, 488,504 pounds of sulfur dioxide and 11,209 pounds of sulfur trioxide came spewing out.

Any one of these chemicals is menacing; the three together are alarming. Only a favorable wind kept the pestilent cloud from invading residential areas.

The problem goes beyond refineries. For instance:

· In March, the TNRCC's mobile lab documented a violation of the residential hydrogen sulfide standard by the American Rockwool insulation factory in Bell County. Eight months earlier, the company had signed a formal agreement with the agency, promising to reduce H2S emissions.

· In early 1995, 54 families in rural Wise County sued Mitchell Energy and Development of The Woodlands, claiming that their water wells had been poisoned by hydrogen sulfide leaking from improperly drilled gas wells. Mitchell Energy says that the contamination occurred naturally.

The case is being tried in segments. In February 1996, at the end of the first phase, a jury awarded eight families $204 million. Mitchell Energy appealed.

At the end of the second phase, tried before a different jury last spring, 17 families came away with nothing. The third phase, involving one family, is set for January.

· As a result of monitoring on June 12, 1996, near G.M. Trading Corp., a lamb-skin processing plant in East San Antonio, the TNRCC warned that occupants of a neighborhood 1,500 feet to the north could experience nausea and headaches because of "high H2S levels." In fact, one mobile-lab technician became ill.

· From September 1994 through February of this year, the agency undertook 107 odor-complaint investigations of the overloaded wastewater treatment plant operated by the city of Crandall, in Kaufman County near Dallas. Violations were found in 27 of the investigations.

Hal Cook sold his house in the Buffalo Creek subdivision, near the plant, at a $45,000 loss just to get away from the recurring stench. "There were times you could not stay inside the house," he said. "We had people in the neighborhood moving out to live in motels."

Victor Bringle, a civil engineer in Dallas who advised the Buffalo Creek residents, concluded that hydrogen sulfide was a likely source of the odors.

· And on Oct. 2, 1996, a TNRCC investigator sampling near an inactive lime kiln at the Champion International paper mill in Lufkin recorded a pollution level so high that it had to be verified by agency engineers in Austin.

Champion's state permit allows it to release up to 5 ppm of total reduced sulfur compounds, including hydrogen sulfide. The reading was 33,000 ppm, or 6,600 times the limit.

This was not an isolated event. Champion routinely shut down the lime kiln at least once a year for maintenance. When it did so, sulfur compounds that typically were burned were simply vented to the atmosphere.

"Nobody knew just how much was coming out during these outage periods," said Vic Fair, the TNRCC's regional manager in Beaumont.

Although Champion was cited, Fair doubts that the citation will stick because the release occurred during maintenance -- a common and usually effective defense -- and the TNRCC received no complaints from the public.

Given that the mobile lab makes only a few trips a year, it is probably safe to assume that many hydrogen sulfide violations go undetected. Some find it lamentable that the TNRCC has not, through more energetic enforcement and more rigorous permitting, compelled known polluters to reduce their discharges.

As things stand, well-connected law firms have a great deal of influence over the enforcement and permitting processes. The public often has little say in either.

The TNRCC "has bent over backward to accommodate the regulated community in the last couple of years," said Cathy Sisk, chief of the Bureau of Environmental and Community Protection of the Harris County Attorney's Office. "It's to the point of ridiculousness."

TNRCC Executive Director Dan Pearson takes umbrage at the suggestion that his agency -- created four years ago with the merger of the Texas Air Control Board and the Texas Water Commission -- has grown servile to industry.

He promises more air monitoring in places like Corpus Christi and Beaumont, harsher penalties statewide for recalcitrant polluters and more thorough analyses of upset data.

Although he sympathizes with them and takes their complaints seriously, Pearson said, residents of Refinery Row, Charlton-Pollard and similarly blighted areas really are saying, "We just don't want these facilities here anymore."

The law, he said, "doesn't give the TNRCC the right to remove refineries from along the coast of Texas," although it is empowered to protect public health and the environment -- and tries to do so.

Still, the perception of the TNRCC as "a lapdog of industry," as one widely traveled environmental consultant put it, did not materialize overnight, or without foundation.

At a briefing in Arlington on Sept. 22, Allyn Davis, regional director of planning and permitting in the EPA's Dallas office, pilloried the TNRCC for its deficient air-monitoring efforts in the most polluted areas of the state.

"We have people with health problems," Davis told representatives of state and local government, business and environmental groups. "We have an obligation."

In researching the public-health risks of hydrogen sulfide, the Chronicle encountered a number of cases that raise questions about the TNRCC's resolve. Here are three:

The tank battery

In 1985, a company called Spain Oil began operating a sour crude tank battery in the small town of Somerset, south of San Antonio in Bexar County.

Tank batteries normally don't get a second look in South Texas, but this one was different. It was right in the middle of town, uncomfortably close to a school, a park and several houses. And it was not in good shape.

Hydrogen sulfide odors from the crude, deterioration of the storage tanks and grass fires possibly ignited by an erratic flare gave rise to a number of citizen complaints that resulted in a TNRCC citation on Dec. 27, 1995.

An agency investigator had noted that the flare -- needed to turn the hydrogen sulfide into less

dangerous sulfur dioxide -- was too short and did not have an automatic source of ignition, rendering it unreliable.

Moreover, Spain Oil had never applied for an air permit, which might have resulted in a public hearing on the tank battery, or a standard exemption, which would have precluded a hearing, providing certain conditions were met.

What to do? A meeting was held at the TNRCC's regional office in San Antonio on Feb. 28, 1996; in attendance were three TNRCC officials and Norman Parker, president of Spain Oil.

According to a memorandum prepared by James Menke, then the TNRCC's air program manager in San Antonio, it was decided that the tank battery did not qualify for any exemption on the books at the time because it was within a quarter-mile of people (including schoolchildren) and produced more hydrogen sulfide (up to 700 parts per million) than was considered safe.

On July 30, 1996, however, Parker was notified by letter that the TNRCC permitting staff in Austin had found a creative solution to his dilemma: The agency would allow him to avoid a potentially acrimonious permitting process by bringing him under two exemptions from 1982. (Spain Oil, of course, didn't exist until three years later).

In short, the TNRCC denied the residents of Somerset an opportunity to comment on a smelly and possibly hazardous tank battery in their midst. Parker paid no penalty for operating out of compliance for 11 years, although he was required to raise the flare, install the automatic ignitor and make other improvements.

"We got them into compliance to protect the neighbors," said Duncan Stewart, the TNRCC permit engineer in Austin who approved the deal.

At the end of last year, however, Somerset Mayor Paul Cuellar was still complaining about Spain Oil and another sour crude operation nearby.

In a letter to the Texas Railroad Commission dated Dec. 16, 1996, Cuellar noted that "serious, noxious odors occur quite often and it is feared by residents and the city that illness ... may result if immediate corrective action is not taken to upgrade these facilities to capture and contain this poisonous gas."

The complaints have fallen off in recent months, Cuellar said, and a joint TNRCC-Railroad Commission inspection in December revealed no hydrogen sulfide levels of concern. "All of the problems have been corrected," Parker said.

Still, a senior Harris County Pollution Control Department official familiar with the state permitting process was astonished to learn what the TNRCC had done for Spain Oil.

"I've never heard of anything like that in my life," said Darhl Ferraro, the department's technical manager. "You don't dig back until you find an exemption that just fits."

A member of the TNRCC's legal staff agreed.

"That shouldn't happen," said senior attorney David Duncan. "They shouldn't claim a standard

exemption that existed before the plant existed."

The Spain Oil case illustrates the TNRCC `s willingness to expedite permitting by granting exemptions and, since 1995, issuing so-called "standard permits for oil and gas," neither of which allows for public hearings.

The ostensible aim is to reduce the regulatory burden on insignificant sources of air pollution. The effect, intended or not, is one of public exclusion.

"I think their main concern is getting those permits out and being a friendly agency to their customer, which is industry," said Rob Barrett, director of the Harris County Pollution Control Department. "I have felt that the actions they have taken are going to come back and haunt them."

The hardship case

In the spring of 1994, the aged Crown Central refinery in Pasadena was facing a TNRCC fine of $579,050 for consistently exceeding the allowable concentration of hydrogen sulfide in its fuel gas and consequently releasing clouds of sulfur dioxide, a lung irritant that smells like burnt matches.

Crown Central's attorney, Pat Finn Braddock with Fulbright & Jaworski in Austin, argued that such a fine would cause an economic hardship for the struggling refinery; that $6.2 million in pollution-control equipment already had been installed and another $3 million to $4 million would be spent; and that Crown Central's emissions "generally pose(d) no threat to public health and safety in the area."

By the spring of 1995, Crown Central's fine had been reduced by 81 percent, to $110,000, on the condition that the company improve its environmental performance.

The violations, however, didn't stop. On July 18 of this year, the TNRCC found itself in the familiar position of citing Crown Central for, among other things, exceeding the hydrogen sulfide limit in fuel gas.

On July 21, three environmental groups and three Pasadena residents sued the refinery under the federal Clean Air Act, alleging that it had recorded more than 12,000 violations and had blanketed the surrounding neighborhoods with "sharp, sulfurous odors."

(Another lawsuit, accusing Crown Central of creating a health hazard and interfering with residents' enjoyment of their property, had been filed in state court on June 25).

The EPA -- which, like Harris County, had been prepared to penalize Crown Central in the early 1990s but had deferred to the TNRCC -- has just completed another inspection of the refinery.

"Quite frankly, it doesn't look very good," said Ray Magyar, an EPA enforcement officer in Dallas. "Even though there was (a TNRCC) enforcement action, it doesn't look like Crown Central has improved the situation any."

Mark Wenzler, an attorney with Trial Lawyers for Public Justice in Washington, which filed

the federal complaint against Crown Central, suspects that "the EPA regrets having let the TNRCC take the lead in the 1994 enforcement action. The penalty the TNRCC obtained was nowhere near the amount necessary to deter illegal conduct."

"Worst of all, the TNRCC didn't make Crown fix the problem, the result being that the pollution continues unabated to this day," Wenzler said.

Braddock, a former senior attorney with the Air Control Board, said that the refinery plans to install a $490,000 backup amine absorber tower -- which should clean up the fuel gas and reduce the number of upsets -- by December.

Crown Central, Braddock said, has made a diligent effort to address the issues outlined by the TNRCC in 1995. "We tried lots of different things," she said, and it was only after these steps were taken that corrosion-related flaws in the amine system were found.

Asked about the large reduction in the 1995 fine, Braddock said: "They (TNRCC officials) were the ones who decided what an appropriate penalty would be, given our financial situation and the alleged violations."

There is a simple premise behind the imposition of swift, firm punishment on chronic polluters.

At a hearing before the Senate Environment and Public Works Committee on June 10, Lois Schiffer, the top environmental lawyer at the Justice Department, testified that "many people ... would not send their tax checks to the IRS next April if tax violations carried no penalty. So, too, we cannot expect voluntary compliance with environmental laws unless those laws are enforced, and enforced vigorously."

An audit by the EPA's inspector general released in September 1996 concluded that the TNRCC, in deciding the appropriate penalty for an air polluter, too often failed to consider the economic benefit a company had realized by being out of compliance.

Although the state Clean Air Act provides for penalties of up to $10,000 per day for each violation, the plants that have drawn many of the complaints in Corpus Christi and Beaumont have avoided big fines.

The Citgo East and West refineries in Corpus Christi, for example, have paid $38,750 in air-pollution penalties since 1986 and nothing since the TNRCC was created in 1993, although an enforcement case is pending.

Last year, Tulsa, Okla.-based Citgo Petroleum Corp. reported revenues of $13 billion.

Phil Vrazel, manager of environmental affairs for the two Corpus Christi refineries, said that the June 18 hydrogen sulfide spike (caused by the bird in the transformer) and other high readings in February (caused by the stoppage of a tower called a sour water stripper) were anomalies and implied no pattern of neglect.

A malodorous proposal

In March, Harris County officials beat back an attempt by the TNRCC to weaken the state's

nuisance-odor rule, a flexible enforcement tool for field investigators responding to complaints about hydrogen sulfide and other rancid compounds.

The TNRCC had pushed legislation in Austin that would have allowed it to investigate only odors that presented a clear risk to public health; odors that merely interfered with quality of life no longer would have elicited an agency response.

"They said it was just too resource-intensive, that they got too many odor complaints and couldn't respond to them all," said Sisk, of the Harris County Attorney's Office. "The appropriate response would have been stronger enforcement. That might mean that, ultimately, you'd have fewer problems to deal with."

The TNRCC, director Pearson explained, had reasoned that it might be time for local governments to take a more prominent role in odor investigation and enforcement.

"I think we got a pretty clear signal that (legislators) wanted it to continue to be a state responsibility," Pearson said.

Not that everyone is happy with the status quo. On Jan. 11, 1995, TNRCC field offices received a directive from headquarters listing the types of complaints they would no longer be expected to investigate. Among these were "recurring unconfirmed complaints."

No doubt some of these complaints are invalid, the product of someone's fertile imagination or grudge against a company. Others, however, may be unconfirmed because it took the investigator days, or even weeks, to respond.

Neighbors of the 2-year-old Mitchell Energy gas-processing plant, near Navasota in rural Grimes County, have a strained relationship with the TNRCC's regional office in Waco.

Although residents insist that the plant reeks, especially at night and on weekends, the agency has been unable to verify a hydrogen sulfide problem -- or any problem, for that matter.

Retirees Harvey and Nell Williams nonetheless have decided to leave their home just east of the plant.

"You can't believe what it does to us," Nell Williams said. "It makes us heavy in our chests. We have this nasty taste in our mouths. I've been up all night with nausea and my eyes just burning. Sometimes I'm afraid I won't wake up."

On Oct. 16, the Williamses and 26 others filed suit against Mitchell Energy, claiming that noxious releases, loud noise and bright light from the plant have greatly devalued their property, harmed livestock and pets, and caused them physical and mental distress.

Mitchell Energy rebuts these accusations. Although hydrogen sulfide levels reach 900 parts per million near a combustion device at the plant called a thermal oxidizer, the gas actually entering the plant has fewer than 30 ppm, said Allen Tarbutton, president of the firm's Gas Services Division.

Even if there were a catastrophic line rupture near the oxidizer, the company said in a filing with the Railroad Commission, debilitating levels of hydrogen sulfide would travel no more

than 328 feet, keeping it well away from people like the Williamses.

"We don't know of anything that would be causing the health concerns they've talked about," said Greg Lewis, environment and safety manager for Mitchell Energy's gas division.

Residents of Refinery Row in Corpus Christi admit to being chronic complainers, but only by necessity. Since 1994, the local TNRCC office has logged nearly 300 calls about the Javelina sour gas processing plant and the Valero, Citgo, Koch and Coastal refineries.

The complainants felt vindicated in February, when the TNRCC's mobile lab detected several elevated hydrogen sulfide readings, including one that "pegged the meter," said Laurel Carlisle, a toxicologist with the agency in Austin.

The Valero and Citgo East and West refineries were, in fact, cited by the TNRCC on May 23. But Neil Carman, clean air program director for the state Sierra Club and a former Air Control Board investigator in Odessa who wrote dozens of hydrogen sulfide and nuisance-odor citations in West Texas, is unimpressed.

"Twenty-five years after the state air program comes into existence and they find these violations in Corpus Christi for the first time?" Carman said. "That's ridiculous. Why didn't this happen 10 or 15 years ago?"

On behalf of the Sierra Club, Carman petitioned the Air Control Board for a stricter residential hydrogen sulfide standard in April 1993; he petitioned the TNRCC in March 1994.

Carman argued that the state was saddled with an outdated standard, adopted in 1973, that put infants and other vulnerable populations at risk. He reminded the TNRCC that "H2S is not an isolated concern in a few small communities," as evidenced by Refinery Row alone. His proposal was to lower the limit from .08 ppm to .01 or .015 ppm.

The petitions went nowhere. Carman, knowing that the enforcement of a lower limit could prove costly for industry, was not surprised.

"It always comes down to money," he said.

Three years ago, Carman and Texas Southern University law Professor Grover Hankins drew up a civil rights complaint against the TNRCC and the city of Corpus Christi on behalf of the predominantly Hispanic and African-American residents of Refinery Row.

The complaint, which alleges environmental racism, is under investigation by the EPA. The allegations have been emphatically denied by both defendants.

The people of Refinery Row, many of whom would like to be bought out, remind outsiders that *they* settled in the area first and the plants came afterward.

They believe that the city conspired with the oil companies to sacrifice once-pleasant neighborhoods such as Hillcrest, and that the TNRCC has given its tacit blessing to stupefying levels of pollution by writing lenient permits and failing to penalize violators.

A week's worth of TNRCC mobile monitoring on Refinery Row in February 1994 did nothing

to temper the residents' suspicions.

Hydrogen sulfide levels as high as .67 ppm -- more than eight times the state residential standard -- were measured downwind of the Valero refinery.

"During this sampling period," Maria Aponte-Pons of the TNRCC's Air Quality Enforcement Division wrote in a memo, "sampling personnel experienced acute respiratory irritation and evacuated the area."

Valero also exceeded the standard for sulfur dioxide. Levels of hydrogen sulfide and sulfur dioxide from the Citgo East, Southwestern (now Koch East) and Coastal East refineries were below the limit but still high enough to cause nuisance odors.

"We strongly recommend that levels of these two compounds be reduced significantly to ensure protection of public health," Aponte-Pons wrote.

Although Valero received a nuisance-odor citation, it paid no fine because its releases were considered unpreventable. Incidents documented since Aponte-Pons made her recommendation suggest that it fell on deaf ears.

The Rev. Harold Branch moved into Hillcrest -- then a neat, largely white enclave -- in 1956 and watched it slide as the area became increasingly industrialized.

"When the refineries started buying over here, the city started relaxing code enforcement," said Branch, pastor emeritus of St. John Baptist Church and a former city council member.

Weeds sprouted. Orange and peach trees withered and died. Entire blocks were blemished by trash and abandoned houses.

"The plants have encroached into the neighborhoods to the extent that there's no breathing room," said Bill Green, regional director of PACE. "They profit off of poverty."

Ethel Simmons, 82, lives about 100 yards from the Koch East refinery's fence.

"I had a beautiful yard, a nice garden with fruit trees," said Simmons, who moved to Hillcrest in 1963. "Now nothing grows, and you get these odors. Sometimes, at night, I don't know what they're doing but it just smells terrible."

The city's official response to major chemical releases on Refinery Row is "Shelter in Place," the concept being to stay in one's home, school or business until the danger passes.

Simmons called this "one of the stupidest things I've ever heard. You could suffocate in your house."

She wishes instead that the plants would be made to control their discharges -- or, better yet, that Koch would offer her a reasonable price for her home so she can move.

"I never would have bought here if that place had been around," Simmons said, nodding toward the refinery.

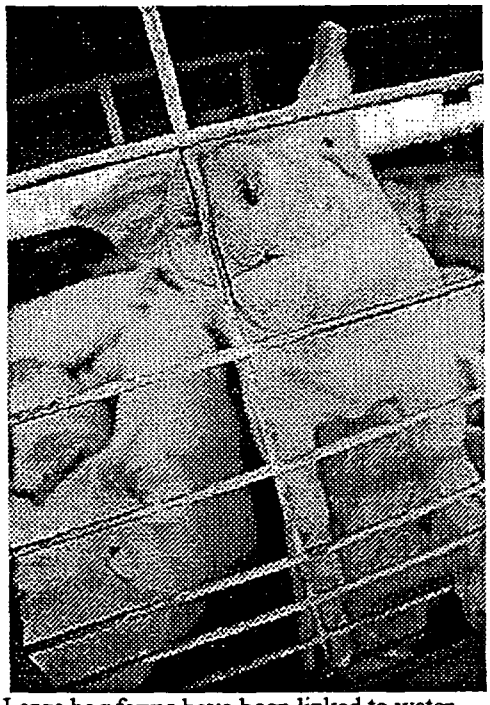
THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

7:54 PM 11/10/1997

Residents not so wild about hog operations

By JIM MORRIS

OCHILTREE COUNTY -- If the proliferation of high-tech hog barns in the Texas Panhandle can be traced to any one event, it is a meeting that took place nearly four years ago in the Amarillo office of state Sen. Teel Bivins.



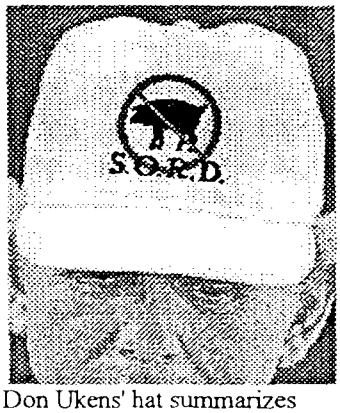
Large hog farms have been linked to water pollution and hydrogen sulfide-related illnesses.

The meeting broke a regulatory logjam, enabling pork producers to quickly establish themselves in virgin territory.

And it helped ensure that they would face little risk of punishment if they polluted the air with hydrogen sulfide or other harmful compounds.

On the morning of Dec. 10, 1993, Bivins, a leading Republican senator and cattle rancher, conferred with five men who had an ardent interest in the state's nuisance-odor rule.

Three were from the Texas Natural Resource Conservation Commission, two from the Texas Cattle Feeders Association (of which Bivins had once been a director).



Don Ukens' hat summarizes the feelings of those opposing the growth of hog operations.

The TNRCC had been aggressively citing cattle feedlots for producing pungent and potentially unhealthful clouds of dust; the feedlot owners, unaccustomed to such treatment, were furious. They turned to Bivins -- whom they considered an ally, and whose campaigns they had supported -- for assistance.

"Senator Bivins said he has had numerous telephone calls from disturbed feedlot operators asking if there is a new law, and rather dumbfounded as to why they were being cited for nuisance violations," the TNRCC's Terry Leifeste, one of the participants in the meeting, wrote in a memorandum.

Bivins asked whether the agency -- in particular, Rick Costa, then its air program manager in Amarillo -- was being "overly enthusiastic in enforcement," says the memo, obtained by the Houston Chronicle under the

Texas Open Records Act.

The senator was assured by the TNRCC officials that this was not the case, that the agency's investigations arose from citizen complaints. The polemic did not end there, however.

By the summer of 1994, records show, Bivins had drawn up a proposal to simplify the state's permitting process for concentrated animal feeding operations, known as CAFOs. A key element was the elimination of public hearings, contingent upon the applicant's meeting certain environmental criteria.

"The perception throughout the United States that the regulatory environment in Texas is burdensome and unfavorable creates disincentives for (CAFOs) to locate in Texas," Bivins wrote to the TNRCC. His aim, he said, was to attract operations that had been moving into states such as New Mexico and Oklahoma.

John Hall, then chairman of the TNRCC, responded promptly, writing to Bivins that the agency had been thinking along the same lines and "agrees with the basic thrust and direction of your proposal."

By the summer of 1995, the TNRCC had changed its CAFO permitting rules, incorporating Bivins' suggestions. Its field personnel were ordered to stop issuing nuisance-odor citations to CAFOs, regardless of how disagreeable their emissions became.

These were the signals that the pork producers -- outcasts in some states because of water pollution and hydrogen sulfide-related illnesses and odors associated with their operations -- had been awaiting.

Into remote Ochiltree County they came, building metal barns in which to fatten up the animals and digging lagoons to hold their liquefied manure.

Today, tens of thousands of hogs are being fed in the county, some by a local man named Dean Paul but most by Texas Farm, a subsidiary of Nippon Meat Packers Inc. of Osaka, Japan, which ships much of its pork to Asia.

For Texas Farm, expansion appears imminent. It already has state permits for 341,593 hogs and 52 lagoons, and it is seeking TNRCC permission to add 307,350 hogs and 64 lagoons.

In the past two years, the TNRCC has received dozens of complaints about sulfur and ammonia odors emanating from the operations' congested barns and stagnant lagoons. The complainants, by and large, are farmers and ranchers themselves and are not easily disgusted.

"There's no way to describe the odor," said Barbara Philipp, who lives about a half-mile west of Texas Farm barn No. 1, which opened last year. "It kind of comes in streams. When it gets into your house it lurks in little corners."

Like many of their neighbors, Philipp and her husband, Bernhard, were farming here long before the pork producers arrived.

"You live here, have a good life, and then this thing comes in," Barbara Philipp said. "It turns your life totally upside down. You just feel invaded."

In a prepared statement, Texas Farm said that "we selected this region because of its environmental soundness" and because it has a "successful history of large-scale animal agriculture operations."

The company said that its lagoons surpass federal and state standards and that it intends to bring "new life" to the local economy by building a $10 million feedmill west of Perryton that will employ 400. It would not disclose the head counts in its barns.

Paul, who is feeding 15,000 hogs in two barns, dismissed his critics as "radicals" who "need a cause."

He said that his permits have "all the safeguards considered for odors and spillage. We don't need a watchdog group to oversee our operations. The TNRCC's got that completely covered."

When word got out in early 1995 that the hogs were coming en masse to Ochiltree County -- as they had several years earlier to Texas County, Okla., just to the north -- some residents formed a group called Active Citizens Concerned Over Resource Development (ACCORD).

The plan, said Jean Gramstorff, one of the organizers, was to demand hearings on every operation.

In June of 1995, however, the TNRCC changed the rules, decreeing that pending permits could be challenged only on matters of technical merit -- clear violations of often-arcane regulations. The mere fact that a barn or lagoon might reek or otherwise be troublesome would not suffice.

"We don't do property value," said Brad Jones, the TNRCC's regional manager in Amarillo. "We don't do truck traffic."

Jones said that he sympathizes with groups such as ACCORD. "I guess they don't know how unempowered environmental agencies have become," he said. "We're frustrated as well."

ACCORD has sued the TNRCC, claiming the rule change deprives property owners of their fundamental right to a hearing prior to the permitting of a feedlot.

The group's attorney, Stuart Henry of Austin, said that such hearings proved invaluable to residents of Erath County, who defeated a number of proposed dairy operations in the early 1990s.

"The state permitting process should not be a formality," Henry said. "It is now, but it shouldn't be."

James Kowis, an agriculture and water-quality specialist with the TNRCC, said that the state adopted its so-called general CAFO permit in an effort to compress what had been a fragmented system and make better use of the agency's limited resources.

"I would say that it's worked fairly well," Kowis said.

Said TNRCC Chairman Barry McBee: "If you compare what Texas requires with what other states require, we are as stringent, if not more stringent. What we require in Texas is protective of the environment and the people around these facilities."

In doing away with site-specific permits and hearings based more on land-use disputes than on actual environmental risks, the state was simply following a national trend, McBee said.

Some in Ochiltree County, however, believe that there is another explanation: successful lobbying by powerful agriculture interests.

Bivins has close ties to agriculture, as do two of the three TNRCC commissioners, McBee and John Baker.

Baker was a director of the Texas Farm Bureau, the Texas Beef Council, the Texas Corn Producers Board and the Lone Star Corn Growers Association prior to his appointment to the TNRCC. McBee was deputy commissioner of the Texas Department of Agriculture.

The makeup of the TNRCC's Agriculture Advisory Committee, formed in November 1993, is noteworthy as well.

Twenty-three of the 24 members are in the industry, representing groups such as the Texas and Southwestern Cattle Raisers Association, the Texas Pork Producers Association and the Texas Association of Dairymen.

Although state law requires that all advisory boards be balanced, there is only one representative of an environmental group: Dede Armentrout of the National Audubon Society.

TNRCC spokesman Pat Shaughnessy said that all of the appointments were made by commissioners who are no longer with the agency. The committee members' four-year terms have just expired, and Shaughnessy said "the current commissioners have expressed some interest in creating greater balance."

Although the TNRCC is the lone defendant in ACCORD's lawsuit, Henry pins the Panhandle hog boom on Bivins.

"He was totally responsible for it," Henry said. "Basically, Senator Bivins has written off the citizens of Ochiltree County. He doesn't care that those folks up there are being stunk out of their houses. I guarantee you Mr. Bivins wouldn't put up with a pig farm next to his mansion."

Bivins said that he is mindful of the Panhandle environment and that "the hog operations on the High Plains have grown faster than I certainly anticipated they would."

However, he said, CAFOs should not be outlawed merely because some of their neighbors find them unappealing.

"While many people would like to use the TNRCC as a sort of rural zoning agency, that's not their job," Bivins said. "Their job is environmental protection."

Bivins said that he convened the December 1993 meeting with the TNRCC and the cattle feeders' association to discuss Costa, the allegedly overeager investigator who had been issuing most of the nuisance-odor citations.

The cattle feeders' complaint was that Costa, in a reversal of agency policy, did not give them time to correct violations before writing them up. Bivins likewise criticized Costa's "gotcha" style of enforcement.

Costa, who attended the meeting and resigned from the TNRCC in August 1996, declined comment.

Several people familiar with his work, however, say that he quit because he could no longer tolerate the agency's hands-off policy toward CAFOs -- especially Palo Duro Feedyard, a 30,000-head cattle feedlot in Hansford County that had drawn an increasing number of complaints about airborne manure as it expanded in the late 1980s and early '90s.

On May 3, 1995, a brown plume extended north from Palo Duro nearly three miles, onto the property of rancher David Bergin. Bergin's son John David, then 2, went into respiratory arrest and had to be rushed by helicopter to a hospital in Amarillo.

"He was in intensive care for several days and in the hospital for over a week," said Bergin, whose ancestors settled in Hansford County in 1884 and who has a lawsuit pending against Palo Duro. "There were questions about his survival during the first few hours."

On July 14, 1995, TNRCC investigator Kathy Palmer inspected Palo Duro in response to a complaint from Bergin.

"The concentration of dust being carried outside the feedlot was adequate to interfere with the normal usage and enjoyment of the property to the north, including (Bergin's) house," Palmer wrote in her report. "The dust could potentially cause adverse physiological discomfort, such as burning and itching eyes, coughing and breathing difficulties, to persons of ordinary (sensitivity). Individuals with compromising health conditions could be more severely impacted."

Seventeen days later, Costa visited the feedlot and noted a similar offsite dust problem. His supervisors in Austin would not allow him to cite Palo Duro for creating a nuisance, however, because he had no proof that homes in the area were affected.

The TNRCC did cite Palo Duro on Feb. 7, 1996, for exceeding its permitted head count, but never rebuked the feedlot for its failure to contain dried manure.

"They didn't directly address the health hazard," said Nancy Stone, an Amarillo attorney who represents Bergin.

Bill O'Brien, managing partner of Palo Duro's Amarillo-based parent company, Texas Beef, said that the feedlot for several years has tried to suppress dust by spraying water on it and regularly cleaning the animals' pens.

"We want to be good neighbors to all the folks up there," O'Brien said.

Bergin and his family have abandoned their ranch for the time being and moved into the nearby town of Gruver. John David's health has improved markedly.

"To me, there's a reason those regulations are in existence," Bergin said. "When you can pretty much ignore them and do what you want, that's really disappointing."

Debra Barber, air program director in the TNRCC's Field Operations Division, explained that the agency's ability to cite a CAFO for nuisance odors was muddled by a 1993 Texas Supreme Court ruling.

In that case, the F/R Cattle Co. of Erath County had contested a citation by the Texas Air Control Board (TNRCC's predecessor), claiming the feedlot's odors were part of a "natural process" and therefore exempt from regulation under the state Clean Air Act. F/R Cattle lost in the trial and appellate courts but won in the Supreme Court.

In light of the decision, Barber sent out a memo in March 1994 instructing the TNRCC's regional offices to submit all proposed CAFO odor citations to a review committee in Austin.

The committee, Barber wrote, would look for evidence of "flagrantly bad management practices, extremely intense impact and/or a pattern of problems at the source."

In the 3½ years since the memo went out, the TNRCC has issued four nuisance-odor citations to CAFOs. All were resolved informally, without the imposition of a fine.

Barber said that she has been searching for a formal enforcement case with which to test the F/R Cattle decision. "I have not seen the right case," she said.

Asked about Palo Duro, Barber said, "We did not confirm a nuisance situation there."

Henry said that the TNRCC is simply "using F/R Cattle as an excuse for not enforcing the rules. There's nothing in the law that prohibits them from doing it."

In no way, he said, could odors from "factory" hog farms be considered natural, nor should their right to make money supersede the rights of adjoining landowners to be free from annoying and possibly hazardous air pollution.

"You can design these facilities not to stink up your neighbors, but it will cost a lot of money and the TNRCC's not willing to require (producers) to do that," Henry said.

The hog farms that have sprung up in the Texas and Oklahoma panhandles have two basic components: the barns, where the animals feed, and the lagoons, which receive enormous volumes of manure flushed from the barns.

"When you combine the waste of any animal -- human, cow, pig, chicken -- with water, you have the conditions for creating septic odors," said Dr. Leon Chesnin, professor emeritus in the University of Nebraska's Department of Agronomy. "If you have an

anaerobic lagoon -- an absence of oxygen in the system -- you can generate hydrogen sulfide. You can also generate ammonia, which has a caustic effect on the tissues, eyes and respiratory systems of the animals -- and humans."

Bivins pointed out that odors are subjective. What is unbearable for one person may be hardly noticeable to another.

There are, however, objective ways to measure hydrogen sulfide. Thus far, the TNRCC's Amarillo office has not monitored for the chemical, despite the presence of some 300 CAFOs in its 26-county region.

For the time being, the people of Ochiltree County must hold their noses and glean what data they can from other states. The picture is not rosy.

Take, for example, the anecdotal evidence supplied by Dave Curtis with Cathodic Protection Services, an oil field service company in Liberal, Kan.

Workers with the firm regularly drive by Seaboard Farms, a huge hog operation in Guymon, Okla. On several occasions last summer, a hydrogen sulfide monitor lying on the seat or the dashboard of the workers' truck began sounding as they neared Seaboard's lagoons.

The monitor, Curtis said, is designed to go off at 10 parts per million. If the readings outside Seaboard were accurate, hydrogen sulfide was present in concentrations at least 125 times the statutory limit in Texas and 1,000 times the limit in New York.

More reliable numbers are available from Renville County, Minn., another cradle of modern hog farming.

Monitoring there has detected hydrogen sulfide levels as high as 1.4 parts per million, more than enough to cause headaches, nausea and diarrhea.

In 1994, two lagoons went in near Julie Jansen's home day-care center in Olivia, Minn. At the time, Jansen was responsible for as many as 17 children.

Once the hog farms came, she said, "I began blacking out. For me to be blacking out, those levels had to be pretty high. A lot of parents pulled their children out because they were getting sick."

By 1996, Jansen was keeping only six children. That year, she said, "we had 140 days of illness among those six kids."

Chuck McGinley, a consulting engineer in Stillwater, Minn., who has worked with residents of Renville County, believes that the symptoms Jansen and others describe are "consistent with low-level, chronic exposures to sulfur compounds" from hog lagoons. He has seen these symptoms in at least a dozen communities, he said.

It is possible to design aerobic lagoons that minimize hydrogen sulfide and ammonia releases, Chesnin said, but "a lot of engineers don't like to propose them to clients because you have to spend money for electricity and equipment and need a larger

surface."

Texas Farm's lagoons in Ochiltree County are anaerobic, but their designer said that this is not inherently bad.

If not overloaded, such lagoons "will give a very complete breakdown of organic matter" with only moderate odors, said Mac Safley, president of Agri-Waste Technologies in Raleigh, N.C.

In some parts of the country, people have taken a firm stand against factory hog farms. On Sept. 16, for example, voters in Seward County (Liberal), Kan., decided by a 3-to-1 margin not to allow any more of the operations to locate there.

In Texas, however, the door remains open, just as Teel Bivins apparently envisioned when he began advising the TNRCC almost four years ago. Since the 1995 rule change, 49 CAFOs -- for hogs, cattle or chickens -- have received permits from the agency.

"We're not seeing an industry expansion -- it's an industry migration," said Don Ukens, a resident of Hooker, Okla., and a leader of Safe Oklahoma Resource Development (SORD), an anti-hog group. "They go places where the state and local officials roll over."

Editor's note: A Chronicle report later this year will examine hydrogen sulfide dangers in the workplace.

THE BRIMSTONE BATTLES: A Houston Chronicle Special Report

7:50 PM 11/12/1997

New alarm over hydrogen sulfide

Researchers document lasting damage to human nervous system

By JIM MORRIS

INDIANAPOLIS -- Exposure to hydrogen sulfide, even in extremely low concentrations, can cause lasting damage to the nervous system, according to research presented here Wednesday, Nov. 12.

Members of a panel at the American Public Health Association's annual meeting discussed study results that challenge the conventional wisdom on the chemical, a highly toxic byproduct of oil and natural gas extraction and refining, as well as other industries. The thinking has been that if an exposure to hydrogen sulfide (H2S) isn't fatal, there are few, if any, lasting effects.

But in his presentation Wednesday, Dr. Kaye Kilburn, of the University of Southern California School of Medicine, said unequivocally that "H2S poisons the brain, and the poisoning is irreversible."

In recent years, Kilburn has studied workers subjected to relatively high doses of the chemical and residents of two California refinery communities -- San Luis Obispo and the Wilmington neighborhood of Los Angeles. Kilburn's subjects underwent extensive neurological testing and showed pronounced deficits in balance, reaction time and other characteristics tested. They also complained of recurring ailments such as dizziness, insomnia and overpowering fatigue.

Three Texas researchers who have just completed their analysis of data collected near a geothermal power plant in Hawaii reported similar findings.

Dr. Marvin Legator and Chantele Singleton, of the University of Texas Medical Branch in Galveston, administered a detailed "symptom survey" to 97 people who live within four miles of the Puna Geothermal Venture. PGV produces electricity from subsurface volcanic heat and gives off hydrogen sulfide in the process.

Eighty-eight percent of the subjects said they had experienced central nervous system impairment of the sort described by Kilburn.

Only 26 percent of those in a control group -- people who live some 20 miles from the plant -- reported such problems.

Dr. Bob Borda, a neuropsychologist in Stafford, put neighbors of the plant through a battery of tests and found that many demonstrated attention deficits and an inability to process information quickly. The condition, Borda said, is analogous to an outdated computer

program: It runs, but it is maddeningly slow and inefficient.

All of the findings presented Wednesday are significant because hydrogen sulfide is common and poorly regulated, as the Houston Chronicle reported in a series of articles earlier this week.

There remains a "tremendous information gap" regarding the chemical's chronic, low-level effects, said Legator, a toxicologist. He is convinced, however, that hydrogen sulfide is a "potent neurotoxin" that does lasting damage.

ANSI

American National Standard

accepted practices for hydrogen sulfide (H_2S) safety training programs

ANSI Z390.1-1995

AMERICAN SOCIETY
OF SAFETY ENGINEERS

AMERICAN NATIONAL STANDARD

Z390 H2S Training Criteria

DRAFT STANDARD

for

SECOND

LETTER BALLOT

MARCH, 1995

Secretariat

American Society of Safety Engineers

Foreword (This Foreword is not a part of American National Standard Z390.1-1995)

The charter ~~and standing of~~ for the American National Standards ~~Z390~~ Committee Z390 on Hydrogen Sulfide (H_2S) Training was accredited by the American National Standards Institute (ANSI) on January 1, 1993. The need for this standards activity grew out of a ~~recognized need for~~ recognition for specialized training ~~for~~ dealing with this toxic chemical, above and beyond conventional ~~H~~hazard ~~C~~communications training, due to numerous fatal accidents involving victims and their would-be rescuers succumbing to the effects of hydrogen sulfide.

Historically, hydrogen sulfide training issues were addressed by only a few industries and the consistency of the training criteria varied greatly from one organization to another. Emphasis placed on student competency may have given way or been sacrificed to meet the immediate timing or financial needs of the organization. For these reasons the standard addresses the individual training criteria which should be incorporated into a comprehensive training course document. These criteria were developed as a result of accepted practices in numerous affected industries. ~~Additionally, consideration~~ Most significantly, emphasis was given to the qualifications and proficiency of individual Hydrogen Sulfide Safety Instructors, as well as student performance-based competency and qualification.

Governmental regulations (see 29 CFR 1910.1200) specify mandatory requirements for training of personnel working with or around toxic chemicals. As a voluntary consensus standard, this document complements those regulations. However, compliance with this standard does not assure compliance with governmental regulations and vice versa.

The Z390 Committee solicits public input that may suggest ~~the need for~~ revisions to ~~this~~ the Standard. Such input should be sent to the Secretariat, American Society of Safety Engineers, 1800 E. Oakton Street, Des Plaines, IL 60018-2187.

This standard was developed and approved for submittal to ANSI by the American National Standards Committee on Hydrogen Sulfide Training, Z390. Committee approval of the Standard does not necessarily imply that all members voted for its approval. At the time of its approv~~ed~~al ~~this~~ the ~~standard,~~ the Z390 Standards Committee had the following members:

SECTION 1 SCOPE PURPOSE AND APPLICATION

1.1 SCOPE. This standard sets forth accepted practices for Hydrogen Sulfide (H_2S) safety training and instruction of affected personnel to include, but not limited to, minimum informational content of the course; recommended exercises and drills; refresher training requirements; H_2S Safety Instructor qualifications; the properties and characteristics of H_2S; sources of H_2S and areas of potential exposure; the typical site specific safe work practices associated with H_2S operations; the detection methods for H_2S; the selection, use and care of ~~personnel~~ personal protective equipment appropriate for atmospheres containing H_2S concentrations above the Threshold Limit Valve-Time Weighted Average (TLV-TWA); and rescue techniques and first aid procedures for victims of H_2S exposure.

1.2 PURPOSE. The purpose of this standard is to establish minimum requirements for site specific H_2S safety training programs which will enhance safety in occupational settings where hydrogen sulfide is present or is recognized as being potentially present, above the ~~Threshold Limit Value - Time Weighted Average~~ (TLV-TWA).

1.3 APPLICATION. This standard is recommended for voluntary application in occupational settings where personnel have the potential to be exposed to concentrations of H_2S in excess of the ~~Threshold Limit Value - Time Weighted Average~~ (TLV-TWA) as established by the American Conference of Governmental Industrial Hygienists (ACGIH).

1.3.1 ~~The~~ These requirements/recommendations apply ~~of this standard are applicable~~ when ~~one or more instructors may be utilized as long as the instructor/administrator~~ the instructor/administrator of the course meets the provisions of the standard. even when one or more assistant instructors presenting the course may not comply.

1.3.2 Should any of the provisions of this standard be deemed not applicable, the other requirements/recommendations of the standard shall still apply.

SECTION 2 DEFINITIONS

Shall -	denotes a mandatory requirement.
Should -	denotes an advisory recommendation.
May -	denotes a permissive statement.
Acute Toxicity -	the acute adverse effects resulting from a single dose of or exposure to a substance.
Acute Exposure -	~~severe, usually critical, often dangerous exposure in which rapid changes are occurring. An acute exposure normally runs a comparatively short course and it's effects are easier to reverse in contrast with a chronic exposure.~~ generally defined as exposure for less than 24 hours. Acute toxicity tests give (1) a quantitative estimate of acute toxicity (LD50) for comparisons to other substances, (2) identify target organs and other clinical manifestations of acute toxicity, (3)

establish the reversibility of the toxic response, and (4) give dose-ranging guidance for other studies.

~~Subacute - an illness or condition that is not quite as serious or as dangerous as the acute phase but may become so if not properly managed~~

Chronic Exposure - ~~repeated exposure to or contact with a toxic substance over a period of time, the effects of which become evident only after multiple exposures. (standard reference sources do not have chronic toxicity definition)~~ long-term or chronic exposures are generally considered when the exposures are longer than 3 months. Chronic toxicity tests are performed to assess the cumulative toxicity effects and carcinogenicity of chemicals.

Contingency Plan - a written document site specific that provides an organized plan for alerting and protecting the public within an area of exposure following the accidental release of potentially hazardous atmospheric concentration of hydrogen sulfide. ~~or sulfur dioxide.~~

Emergency Procedures Plan - an emergency procedures plan is a set part of a broader and more comprehensive Contingency Plan. The emergency procedures plan would include but not be limited to such items as the responsibilities of personnel; the immediate action plan; telephone numbers and communication methods;

location of nearby residences, businesses, schools, churches, medical facilities, emergency response personnel; safety equipment and supplies available, and the evacuation routes. It would outline the immediate steps and actions that would be taken in the event of a major release of toxic material.

Equivalent - means in this standard where instructors, facilities, equipment, course design, etc. provide equal performance.

Instructor/Administrator - ~~hydrogen sulfide safety instructors are persons who have~~ An individual or a corporate entity with an individual who has successfully completed a course in hydrogen sulfide ~~instructor~~ training from an institution or organization offering such courses, or ~~have~~ has received equivalent instruction from a company-designated hydrogen sulfide safety instructor/trainer, or have had equivalent instructor/trainer experience.

Non-Essential Personnel - those individuals who are not required to provide proper and prudent safe operations activities and/or effect control of the hazardous conditions associate with hydrogen sulfide~~, or sulfur dioxide conditions.~~

Visitor - a non-regularly assigned individual who is visiting the job-site for a short period of time, and who is not required to

provide any of the operationally or control activities at the site.

Venting - the process of discharging a material to the atmosphere through a series of piping and/or venting devices, with the discharge point located a safe distance above the ground and away from work areas, and is designed to facilitate proper and safe dispersion of toxic materials and minimize personnel exposure.

Flaring - the process of safely burning of the flammable vapors being discharged from a vent piping/line.

SECTION 3 TRAINING CRITERIA (ELEMENTS)

3.1 Physical & Chemical Properties of H_2S

3.1.1 The physical and chemical properties of H_2S, including but not limited to the following, should be discussed as part of the H_2S training as appropriate for the facility.

Synonyms: Sulfureted hydrogen, hydrosulfuric acid, dihydrogen sulfide, rotten egg gas, swamp gas, meadow gas, stink damp, etc.

Chemical Family: Inorganic sulfide

Chemical Formula:	H_2S
Normal Physical State:	Highly toxic, colorless gas, slightly heavier than air. Vapor Density (specific gravity) at 59 °F (15 °C) and 1 atmosphere = 1.189 and may collect in low-lying areas or confined spaces.
Autoignition Temperature:	500 °F (260 °C)
Boiling Point:	-76.4 °F (-60.2 °C)
Melting Point:	-117.2 °F (-82.9 °C)
Flammable Limits:	4.3 - 46 percent vapor by volume in air.
Solubility:	Soluble in water and oil; solubility decreases as the ~~fluid~~ temperature of water or oil increases.
Combustibility:	Burns with a blue flame to produce sulfur dioxide (SO_2), a very irritating gas with a pungent odor. Sulfur dioxide is a colorless gas appreciably heavier than air, with a vapor density (specific gravity) at 32 °F (0°C) and 1 atmosphere = 2.26.

Odor and Warning Properties: Hydrogen sulfide has an extremely unpleasant odor, characteristic of rotten eggs, and ~~is easily~~ may be detected easily but only at low concentrations. ~~However,~~ dDue to rapid onset of olfactory fatigue and paralysis ~~(inability to smell)~~ (loss of human sense of smell) ODOR shall not be used as the ~~only~~ ONLY warning for the presence of ~~H2S.~~ H_2S.

3.1.2 Incompatibilities and Reactivities

- Contact with strong oxidizers and oxidizing materials may cause fire or explosions. ~~Hydrogen sulfide attacks many metals, which results in the formation of sulfides.~~ and may cause sulfide stress cracking (Hydrogen embrittlement).

- H_2S dissolves in water to form a weak acid that can cause corrosion and pitting of metal.

- ~~Almost all~~ Many metals will react with H_2S to form metal sulfides. It may react with iron/~~steal~~ steel to form iron sulfide, which can be pyrophoric (ability to ignite spontaneously upon contact with air).

3.2 Sources of H_2S

3.2.1 Students shall be informed of the following sources of H_2S:

- Natural Sources:

  Hydrogen sulfide is produced in nature primarily through the decomposition of organic material by bacteria. It may develop in low oxygen environments such as bogs, swamps and polluted water. The gas also occurs as a natural constituent of natural gas, petroleum, sulfur deposits, volcanic gases and sulfur springs.

- Industrial Sources:

  In industrial operations, H_2S is either a product, by-product or waste material. As a by-product, H_2S is often recovered in industrial operations and converted to elemental sulfur or sulfuric acid. (See Appendix A for listing of occupations with potential H_2S exposures re Generation.)

3.3 Human Physiology and Medical Evaluation

3.3.1 *Human Physiology information.* An overview of the respiratory system and the eyes shall be presented. The target organs and body structures subject to the effects of H_2S shall be identified. These include, as a minimum, the following:

the olfactory nerves;

the lungs;

the brain;

the respiratory control center;

and the eyes.

3.3.2 Signs and Symptoms of H_2S *Exposure Associated with Acute Toxicity*. The signs and symptoms of H_2S exposure associated with acute toxicity shall be presented. These include:

olfactory paralysis;

eye irritation;

headaches;

nausea;

diarrhea;

dizziness;

confusion;

staggering gait;

cardiac arrest.

excitement;

coughing;

sneezing;

irritation of the respiratory tract;

pulmonary edema;

respiratory arrest;

brain damage;

photophobia; and

3.3.3 *Signs and Symptoms of H_2S Exposure associated with Chronic Toxicity*. The signs and symptoms of H_2S exposure associated with chronic toxicity shall be presented. These include:

eye irritation

corneal blistering, pitting, opacity

headaches

nausea

irritation of the respiratory tract

pulmonary edema

anorexia

sleep disturbances

3.3.4 *Variables/Affecting the Symptomatology of H_2S Exposure.* Information concerning variables that determine the symptoms associated with H_2S exposure and the speed of their onset shall be presented. The primary variables are exposure concentration, exposure frequency, duration of exposure, and individual variables. Individual variables include:

body mass;

overall physical condition;

age;

smoker/nonsmoker;

and personal biochemistry.

3.3.5 *Interaction of Drugs and Alcohol with H_2S.* The presence of alcohol, prescription medications and/or illicit drugs in the body which may result in hyper sensitivity to the effects of H_2S, shall be presented.

3.3.6 ~~Medical Evaluation~~ *Medical Evaluation*. The necessity of a medical evaluation in determining whether or not respiratory protection can be ~~effectively~~ utilized effectively shall be discussed (Refer to Appendix C for ANSI Z88.2 and Z88.6.)

3.4 Work Procedures

3.4.1 Workers involved in operations where hydrogen sulfide may be present should understand that proper work procedures and practices can greatly reduce the potential for accidents. Workers involved in potential H_2S operations, ~~especially supervisors~~, shall be trained in proper safe work procedures.

3.4.2 Safe work procedures and practices should include but are not limited to:

- conduct site specific safety meetings
- verify that workers are properly trained
- maintain compliance with permit requirements
- provide, at least, one (1) stand-by person qualified to perform first-aid and CPR
- verify that proper safety equipment is available, functioning ~~property~~ properly, and is utilized
- check and remain aware of wind ~~contribution~~ conditions and direction. Start on the upwind side whenever possible when working on equipment
- perform a thorough check of the downwind area prior to the start of any potentially hazardous work activity. Check for personnel and ignition sources
- notify supervisory personnel, when necessary, prior to initiating operations that could involve the release of H_2S
- use the "buddy system" and never work alone in H_2S area

- monitor conditions through implementation of an H_2S detection and/or monitoring strategy
- ventilate work areas, vent or purge lines on vessels prior to beginning work activities
- keep non-essential personnel away from work area
- never take short-cuts

3.5 Personal Protective Equipment

3.5.1 Students should be provided with appropriate training for industry specific items of personal protection equipment.

3.5.2 Emphasis should be placed on respiratory protection training as recommended by current American National Standard Institute (ANSI) standard ANSI Z88.2, "Practices for Respiratory Protection".

3.5.3 Special information should be given on the following:

- Location of Supplied Air Respirators (SAR)
- Location of spare air cylinders, if applicable
- Site specific issues
- Situations that would require respirators
- Limitations & capabilities of positive pressure/full face piece respirators

- Limitations and capabilities of air supplied and air purifying respirators
- Brand/model/size of respirators available

3.6 Use of Contingency Plan and Emergency Response

3.6.1 Students should be taught the purpose of the plan as a logical step-by-step approach to dealing with an emergency.

3.6.2 Students should be familiarized with the content of the plan which may be included as applicable, but not limited to the following:

- Iinstructions for alerting employees and the public in case of an emergency.
- Pprocedure for requesting assistance and follow-up action to remove the public from the area of exposure.
- A a call list of people to notify in the event of an emergency:
- Pplat of area showing location of public areas, location of evacuation routes and assembly places, location of safety equipment, telephones, and if required, radius of exposure.

- ~~L~~list of names and telephone numbers of residents within the area of exposure and the person responsible for any public area.

- ~~P~~provision for advance briefing of the public within an area of exposure.

- ~~D~~detailed operating procedures to be followed in an emergency including instruction of specific job assignments for personnel.

- ~~D~~detailed remedial procedures to be followed in any emergency.

- ~~E~~emergency medical services available including current names and phone numbers. (Prior contact should be made with designated medical facilities.)

- ~~L~~location of the contingency plan.

3.7 Burning, Flaring and Venting of H_2S

3.7.1 Students should be made aware that in some affected industries flaring or venting lines would be provided in work places where there is a probability that H_2S would be present in concentrations of more than 15 ppm. This is an engineering control to minimize worker exposure.

3.7.2 Students also should also be made aware that burning of H_2S results in sulfur dioxide ($S0_2$). Therefore, appropriate training for $S0_2$ ~~would~~ may be necessary.

3.8 State and Federal Regulatory Requirements

3.8.1 Students should be aware of the importance of understanding the existence of regulatory requirements concerning hydrogen sulfide. There may be differences between regulatory requirements that are adopted and enforced by different agencies.

3.8.2 Numerous ~~A~~agencies exist which reference or provide standards/guidelines concerning hydrogen sulfide. They include but are not limited to:

a. ~~DOL~~U.S. Department of Labor, Occupational Safety & Health Administration (OSHA)

b. State OSHA plans

c. American Conference of Governmental Industrial Hygienists (ACGIH)

d. U.S. Department of the Interior Minerals Management Service ~~(Department of Interior)~~

e. U.S. Coast Guard

f. ~~EPA~~ U.S. Environmental Protection Agency (EPA)

g. Bureau of Land Management

h. ~~NIOSH~~ U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health (NIOSH)

i. Various state regulatory agencies

j. Environment Canada

k. Workplace Hazardous Materials Information System (WHMIS)

3.9 H_2S Release Dispersion Models

3.9.1 Students may be apprised that dispersion models should be considered when H_2S concentrations and volume have a potential to impact personnel or the public to the extent that an emergency condition may result from accidental release. Individual industries should conduct an evaluation of their specific H_2S operations to determine if dispersion models are appropriate.

3.9.2 Dispersion models are available for predicting conditions that may result from a release of H_2S. Computer driven H_2S dispersion models have gained acceptance for use in emergency planning. Vapor cloud travel and exposure concentrations over specific time periods may be calculated. The validity of dispersion modeling increases with the accuracy of the H_2S data input into the model.

3.10 Rescue Techniques, First Aid and Post Exposure Evaluation

3.10.1 RESCUE TECHNIQUES

Students shall be trained in proper rescue techniques applicable to their specific work environment. Emphasis shall be placed on the importance of protecting one's self prior to attempting a rescue.

3.10.2 FIRST AID

Students shall be instructed in the importance of activating the emergency medical services system. In addition, students ~~should~~ shall receive appropriate training in rescue breathing and CPR.

3.10.3 POST EXPOSURE EVALUATION

Students shall be informed that individuals overcome by H_2S shall receive medical approval prior to returning to the workplace.

3.11 Methods of Detection and Monitoring

3.11.1 Each type of detector and monitor has its own set of capabilities and limitations with which the user(s) ~~must~~ shall be familiar. When training students on Methods of Detection and Monitoring the instructor shall be knowledgeable, and shall place emphasis, on the site specific type(s) of detection and monitoring devices (and sampling strategy) available to or for the benefit of workers. Training shall include an explanation of the warning alarms indications (if applicable) and emergency response procedures associated with the specific type of detection and monitoring devices available to or for the benefit of workers.

3.11.2 Training shall include the following as applicable:

- Type(s) of detector(s) and/or monitor(s) available
- Manufacturer's recommendations
- Purpose(s), suitability, capabilities, limitations, calibration, function testing, placement, use, and maintenance of detector(s) and/or monitor(s) available.

3.12 Engineering Controls

Training should include discussion regarding ~~engineering controls available~~ various worksite alternatives with emphasis placed on site specific engineering controls. ~~Example may include~~ Students should be familiarized with the following:

- Design or remodeling of worksites.
- Enclosed worksites.
  - Ventilation Equipment
  - Monitoring Equipment

~~- Ventilation equipment.~~

- Metallurgical properties of equipment.
- Burning, flaring and venting of H_2S.

~~- Chemical approaches.~~

- Containment.

- Dispersion

3.13 Transportation of Hydrogen Sulfide Cargoes.

3.13.1 If applicable, students should be made aware of the modes of transportation involving known or potential H_2S hazards such as:

- Maritime
- Highway
- Rail
- Air
- Pipelines

3.14 Emerging Technology

3.14.1 Where applicable, special emphasis should be placed on emerging technologies in the areas of respiratory protection equipment, portable and fixed detection and monitoring devices, as well as the development of chemical treatment technologies that could potentially reduce the presence of H_2S.

3.14.2 The instructor(s) of H_2S training should be required to remain aware of advances in technology.

SECTION 4 INSTRUCTOR QUALIFICATION AND PROFICIENCY

4.1 Hydrogen Sulfide Training Instructors/Administrators shall have successfully completed an appropriate H_2S train-the-trainer development course, or by virtue of significant past experience instructing this discipline, the ~~candidate~~ instructor/administrator must be able to demonstrate his/her knowledge of the technical aspects of hydrogen sulfide training and proficiency in training techniques relative to H_2S. Training credentials or certification from a recognized or accredited training authority would constitute qualification under this section.

4.2 Qualified H_2S instructors should ensure that the comprehensive outline for their individual course of instruction includes all of the topics covered in this standard. No class should ever be abbreviated in the interest of time or any other conflicting factors.

4.3 H_2S instructors/administrators shall conduct a minimum of two (2) H_2S training classes each year. Documentation should be maintained to substantiate evidence of these sessions. Every three (3) years, instructors should attend an H_2S instructor refresher course.

4.3.1 The above requirements/recommendations in 4.3 will permit the instructor to receive the most recent technical information, regulatory changes, and updated data on technologies advancements including but not limited to, personal

protective equipment and monitoring or detection devices, medical advancements and instructional techniques.

SECTION 5 DOCUMENTATION AND RECORDKEEPING

5.1 **Program Documentation.** Documentation detailing the content of the training program shall be developed and maintained. This documentation shall include:

- ~~N~~names of instructors/administrators qualified to teach the program;
- ~~A~~an outline containing the information which must be presented;
- ~~A~~a copy of printed materials supplied to students;
- ~~T~~titles of audiovisual materials presented to students;
- ~~A~~a description of gas detectors and respiratory protection equipment used in the program;
- ~~A~~a description of hands-on-exercises; and
- ~~A~~a description of the type of proficiency examination.

5.2 **Class Documentation.** A record of training shall be created to include the:

- Name of the instructor;
- Name and address of the training provider(s) with which the instructor is affiliated;
- Name of the student and his/her employer;
- Date of training;
- Duration of training; and
- Model of respiratory and gas detection devices the students are trained to use.

5.3 **Certification Card.** A certification card should be provided to include the:

- Name of the student;
- Signature of the instructor;
- Date of training;
- Name of the training provider with which the instructor is affiliated;
- Address of the facility where the training record is maintained; and
- Model of respiratory and gas detection devices the student is trained to use.

5.4 **Recordkeeping.** A copy of program and class documentation and the certification card shall be kept by the training provider with which the instructor is affiliated for, at least, ~~five (5)~~ three (3) years. The student's employer, if different than the instructor's, should also maintain copies of class documentation for, at least, five (5) years.

SECTION 6 STUDENT COMPETENCY AND QUALIFICATION

6.1 Student competency is required at the end of the training in order to receive appropriate qualification. This performance-based competency shall be demonstrated through an evaluation mechanism designed to evaluate the student's understanding of the materials presented throughout the training and use of

demonstrated equipment. Common forms of competency-based evaluation include written, verbal or practical evaluations. Documentation of the student's ability to demonstrate such competency shall be retained as substantive proof.

6.2 Due to the extreme hazard involved in H_2S operations, each individual covered by this standard should complete an annual retraining process.

SECTION 7 TRAINING TECHNIQUE, LANGUAGE AND LITERACY FACTORS

7.1 Hydrogen Sulfide training should be student-oriented and focused on the skills and knowledge required to work safely in an H_2S environment. Each H_2S environment may have differing requirements for safety. The information in Appendix B shall provide a guide in development of H_2S training.

7.2 An approach to structuring a course outline may resemble the guide offered in Appendix C.

SECTION 8 PROTECTION REQUIREMENTS FOR VISITORS

8.1 Attention shall be given to site specific policy concerning evacuation of visitors in the event of an emergency.

8.2 At a minimum these persons shall be briefed on the following:

- Site specific sources of H_2S;
- Health hazards of H_2S;

- Routes of egress;
- Emergency assembly areas;
- Applicable alarm signals;
- How to respond in the event of an emergency.

SECTION 9 RELATED STANDARDS

9.1 This standard is intended for use in conjunction with the following American National Standards or latest revision:

American National Standards Institute, ANSI Z49.1-1988.
"Safety in Welding and Cutting."

American National Standards Institute, ANSI Z88.2-1980.
"Practices for Respiratory Protection."

American National Standards Institute, ANSI Z88.6-1984.
"Physical Qualifications for Respirator Use."

American National Standards Institute, ANSI Z117.1-1989.
"Safety Requirements for Confined Spaces."

APPENDIX A

~~Magnitude of H_2S Generation~~

~~The amount of production of H_2S is affected by several variables including the following:~~

- ~~Temperature; for every one degree centigrade rise in temperature there is a seven percent increase in production of H_2S.~~
- ~~High humidity, velocity and turbulence also tend to increase production of H_2S.~~
- ~~Toxicity is enhanced by the presence of dust and other gases like CO, CO_2, CS_2, NH_3 and SO_2.~~
- ~~A pH between 6.5 and 7.5 causes maximum generation of H_2S.~~
- ~~Whereas, highly alkaline industrial waste tends to reduce H_2S.~~

Occupations with Potential H_2S Exposure

Animal fat and oil processors
Animal manure removers
Artificial-flavor makers
Asphalt storage workers
Barium carbonate makers
Barium salt makers
Blast furnace workers
Brewery workers
Bromide-brine workers
Cable splicers
Caisson workers
Carbon disulfide makers
Cellophane makers
Chemical laboratory workers, teachers, students
Cistern cleaners

Citrus root fumigators
Coal gasification workers
Coke oven workers
Copper-ore sulfidizers
Depilatory makers
Dyemakers
Excavators
Felt makers
Fermentation process workers
Fertilizer makers
Fishing and fish-processing workers
Fur dressers
Geotherman-power drilling and production workers
Glue makers
Gold-ore workers
Heavy-metal precipitators
Heavy-water manufactures
Hydrochloric acid purifiers
Hydrogen sulfide production and sales workers
Landfill workers
Lead ore sulfidizers
Lead removers
Lithographers
Lithophone makers
Livestock farmers
Manhole and trench workers
Metallurgists
Miners
Natural gas production and processing workers
Painters using polysulfide caulking compounds
Papermakers
Petroleum production and refinery workers
Phosphate purifiers
Photoengravers
Pipeline maintenance workers
Pyrite burners
Rayon makers
Refrigerant makers
Rubber and plastics processors
Septic tank cleaners
Sewage (Waste Water) treatment plant workers
Sewer (Waste Water Treatment) workers
Sheepdippers
Silk makers
Slaughterhouse workers
Smelting workers
Soapmakers
Sugar beet and cane processors
Sulfur spa workers
Sulfur products processors
Synthetic-fiber makers
Tank gagers
Tannery workers
Textile printers
Thiophene makers
Tunnel workers
Well diggers and cleaners
Wool pullers

APPENDIX B

Training Techniques, Language and Literacy Factors

Every trainer should ask the question: "What is it that the student must be able to do as a result of this training?" This approach is better than creating instructor-oriented training by asking: "What am I going to present?" The information in this section may be used to assist a trainer in preparing an H_2S training course or to aid in evaluating the quality of contractor training programs.

Writing Performance-Based Objectives

The trainer should begin the design of his training materials by writing performance-based objectives that clearly indicate how the student will demonstrate the knowledge or skill. Performance-based objectives generally contain 4 basic components. These are:

Audience - A clear identification of who the objective is written for. Some objectives may be for supervisors, first-line workers, contractors etcetera.

Behavior - This component identifies the actual behavior of how the student will demonstrate the task or knowledge.

Condition - Identify the conditions under which the student will perform the task or demonstration.

Degree - Quantify how often or to what extent the student must be correct. For example, if your evaluation tool is a multiple choice test, identify the passing grade allowed.

The following is a comparison of two training objectives:

Objective 1 - The student will know the hazards of H_2S.

Objective 2 - Given a list of health hazards, confined space entrants will be able to identify the health hazards that occur with exposure to various concentrations of H_2S. The student will demonstrate this knowledge by matching the health effects to a given concentration range. The responses must match the instructor answer key.

In the second objective the four conditions of a performance-based objective are met. It can be seen that when objectives are clearly written, the evaluation tool is also easily determined. Sound objectives are the basis for any type of training program, regardless of the platform. The next section provides an overview of the different modes of training delivery.

Delivery of Training

Training may be delivered in a variety of platforms. Making an appropriate choice will be a function of identifying:

The Audience - Characteristics that you will want to identify regarding your audience include:

Entry Level Knowledge	Age
Interest in the Topic	Gender
Preferred Learning Style	Education Level

The Location - Where is the training to take place? Training limitations on an off-shore platform may be very different than those encountered in a land-based operation.

Type of Learning - There are different levels of learning. Knowledge level information, for example reciting health risks, may be conveyed effectively with a book, whereas motor skills, such as donning an SCBA, may require hands-on tutoring.

Resource Constraints - Other limitations such as budget, available development time, or available trainers may drive you toward a particular instruction platform.

Booklets, Brochures and Programmed Learning Texts

Advantages

1. Self-paced
2. Inexpensive to produce
3. Easy to update
4. Able to use in a variety of settings; Very portable
5. A large volume of information can be presented

Limitations

1. Limited interactivity
2. No graphics or motion-based concepts can be covered
3. Not good for complex topics

Instructor-Led Training

Advantages

1. Good for complex issues; Trainer is available to answer questions
2. Inexpensive
3. Instructor can present a large volume of information
4. Instructor is present to ~~asses~~ assess students as they progress in the class
5. Good for demonstration and evaluation of hands-on, motor type skills

Limitations

1. Dependent of skills of the instructor
2. Poor retention of information by students
3. Not self-paced
4. Not good for visual concepts

Video Training

Advantages

1. Good for illustrating visual and motion-based concepts
2. Good at illustrating behavior
3. Useful for affective or "attitude" type objectives
4. Repeat consistency

Limitations

1. Expensive and time-consuming to produce
2. Usually delivery is linear
3. Not very interactive
4. Often used stand alone by trainers to satisfy training requirements

Computer-based Training

Advantages

1. Good for knowledge level objectives
2. Self-paced
3. Interactive
4. Available on demand
5. Consistent delivery of information
6. Visually interesting

Limitations

1. Hardware requirements may be a logistical problem
2. Not good for very complex information
3. Can be costly to develop
4. Students must be comfortable with computers

Interactive Multimedia

Advantages

1. Self-paced
2. Full motion video can be incorporated, lending video advantages
3. Very interactive
4. Good for learners accustomed to advanced technology

Limitations

1. Very expensive to produce
2. Limited off-the-shelf offerings available
3. Hardware requirements may be extensive

Tips for Delivering Good Instructor-led Training

While technology-based training media such as CBT and laser disk programs are very useful, the reality is that most training is still delivered with instructors. The following information is provided to assist in the development and delivery of effective instructor-led training.

Use a Variety of Media

Instructors should use as may different types of presentation aides as possible. These include:

1. Slides
2. Transparencies
3. Flip Charts
4. Demonstration
5. Videos

These graphic aids should be colorful and present consistent visual cues. Slides and transparencies should have colorful, relevant graphics that support the text. If possible, text-only slides should be avoided. Slides with lists should be limited to 5 items or less.

Use Interactive Techniques

Training must involve the student. Use open-ended questions to draw responses from your students. Use flip charts to list student responses. Seeing their responses in writing in front of the class, validates the student's answer and creates interest. Develop the student materials so that they involve the class throughout the lecture segments. For example, rather than just telling a class that the permissible exposure limit for H_2S is 10ppm, have a blank in the student manual where they write the number in. Writing information down increases retention.

Use Humor and Creativity

Humor can be effectively used in training classes to break the tedium and increase attentiveness. Humor used in training classes should follow some simple rules:

1. Humor should be culturally appropriate. Avoid ethnic, religious or political humor.

2. Self-effacing humor can be very effective. Studies have shown that instructors maintain credibility even when using jokes about themselves.
3. Avoid insulting or directed humor.
4. Be sensitive to the audience. A joke about hunting or golf may not play well in a class full of women.

Apply creative thought to the construction of your delivery material and your exercises. Exercises can take on the form of games, allowing drill and practice on information in a fun manner. For example, a trivia-type format for refreshing students on previously delivered information can be very effective and draw students into participating.

Evaluate Training

A training course should be evaluated every time it is delivered to assess quality. Evaluation is divided into four levels:

Level 1 - This is a subjective evaluation by the student of the ~~curse~~ course. Questions regarding instructor presentation skills, accommodations, pace, and usefulness of content may be asked.

Level 2 - An in-class assessment of how well the students learned the material. Frequently this is a paper-based test. For motor skills such as donning an SCBA, an instructor critique with the use of a checklist may be a more appropriate level 2 evaluation.

Level 3 - At this level, an assessment is done on whether or not the student has integrated his skills and knowledge on the job. This type of evaluation is usually done by supervisor observation at some point after the training course.

Level 4 - At this level, trainers attempt to determine a return on the training investment. Usually with safety training this is not a straightforward process. It is difficult to estimate the money saved from an accident that does not occur. Some estimation may be possible if a drop in accident frequency occurs after the training and that drop can be attributed to the training.

Language and Literacy Factors

Language

Training should always be delivered in the native language of the student when possible. If not possible, the following conditions should be followed:

1. Ensure that the student is fluent enough to understand the course material.

2. For instruction and exercises, pair a less fluent student with a fluent bilingual.

3. Avoid use of colloquialisms or local expressions. For example, an expression like "up a creek without a paddle" may not be meaningful to someone not fluent in American English.

4. Evaluation instruments, such as tests, may need to be orally administered.

5. Training material should be as visually oriented as possible. For example, use a picture of a respirator next to the word.

Literacy Factors

As with employees who may speak English as a second language, written English literacy may be a problem for some students. If this is determined to be the case, the following conditions must be followed:

1. Student should be able to demonstrate recognition of warning signs and state the intended message.

2. Evaluation instruments, such as test, may need to be orally administered.

3. Responsible persons must determine that the individual does not represent a safety hazard on the job to himself or others.

4. As with second language students, the training should be visually oriented.

APPENDIX C

COURSE TITLE HYDROGEN SULFIDE (H_2S) CERTIFICATION

TIME 4 Hours

COURSE DESCRIPTION

Hydrogen Sulfide Certification is designed as a safety awareness program to familiarize students with the dangers associated with working in an H_2S environment. The class is appropriate for entry level through supervisory level employees. The course is required for all employees who have the potential to be exposed to H_2S in excess of the Threshold Limit Value - Time Weighted Average (TLV-TWA) as established by the American Conference of Governmental Industrial Hygienists (ACGIH). Annual refresher training is required.

Course materials include student handouts and a final examination. Delivery is accomplished through lecture, hands-on demonstration of monitors and detectors, student participation and practice, video tape, overheads, and student exercise for donning/doffing the self-contained breathing apparatus.

COURSE OUTLINE

I. WHAT IS H_2S

A. Toxicity

B. Common Names

C. How is H_2S Formed?

II. COMMON INDUSTRIAL SITES

A. Petro-Chemical

B. Petroleum Exploration & Production

C. Manufacturing

D. Agricultural

III. PROPERTIES & CHARACTERISTICS OF H_2S

A. Physical Properties

B. Chemical Properties

IV. CONCENTRATIONS/TOXIC LEVELS

A. ACGIH TLV/TWA

B. OSHA PEL/TWA

C. Exposure Levels

D. Toxic Gas Comparisons

V. VIDEO - "Hydrogen Sulfide - A Matter of Life or Death"

VI. H_2S EFFECTS ON INDIVIDUALS

A. Entry Routes

B. Susceptibility and Hypersusceptibility

VII. DETECTION AND MONITORING

A. Personal, Portable & Fixed Monitors and Detectors

B. Chemical vs. Electronic Instrumentation

VIII. CONTINGENCY & EMERGENCY RESPONSE PLANS

IX A Respiratory Protection

A. Air Purifying Respirators vs. Air Supplied Respirators

B. Types of Air Supplied Respirators

1. Self-Contained Breathing Apparatus

2. Airline Respirator with Egress Bottle

3. Escape Pack

C. Special Problems

1. Corrective Glasses/Contact Lenses

2. Facial Hair

3. Facial Characteristics

D. Medical Considerations

1. Pulmonary Function Testing

2. Tympanic Membrane

3. Claustrophobia

E. Maintenance and Inspection

F. Donning and Doffing Exercise

IX. RESCUE, FIRST AID TECHNIQUES AND POST EXPOSURE EVALUATION

A. Emergency Rescue

B. Rescue Breathing & CPR

C. Medical Follow-Up

X. FINAL EXAMINATION

Complementing the course outlines are the following aids and references:

STUDENT HANDOUT ORIGINALS

1. Class Roster
2. Ten Commandments of Hydrogen Sulfide (H_2S)
3. Case Histories of H_2S Accidents
4. Hazards and Characteristics of H_2S
5. Final Examination
6. Safety Passports

OVERHEADS

1. Ten Commandments of Hydrogen Sulfide (H_2S)
2. Hazards and Characteristics of H_2S (2)
3. Toxicity of Hydrogen Sulfide to Men
4. Toxicity of Various Gases
5. Common Sources of H_2S
6. Industries & Activities with Occupational Exposure to H_2S
7. Methods of Detection
8. H_2S Detection and Monitoring
9. Hydrogen Sulfide Monitors
10. Chemical Detectors (2)
11. Tutweiler Apparatus
12. Electronic Detectors (2)
13. Outline for Developing a Contingency Plan (3)

AUDIO/VISUAL EQUIPMENT REQUIREMENTS

A. Chalkboard, chalk, eraser or dry-erase marker board, markers and eraser

B. Flip chart ~~w/paper~~ with paper, and markers

C. Overhead projector and screen

D. 1/2" VHS player and color monitor

E. Pointer

F. 33mm Slide Projector and Screen.

REFERENCES, REGULATIONS AND STANDARDS

A. Videos - "Hydrogen Sulfide - A Matter of Life or Death"
18 Minutes
Coastal Video Communications Corp.
3083 Brickhouse Court
Virginia Beach, VA 23452
(800) 767-7703

Hydrogen Sulfide
"Don't Let it Get You Down"
Its Industrial Training System Corp.
9 East Stow Road
Marlton, NJ 08053
(800) 727-2487

"One Breath Away"

7 Minutes

Safety Short Productions, Inc.

2960 N. 23rd St.

LaPorte, TX 77571

(800) 458-2236

"The Silent Sniper"

7:35 Minutes

Industrial Training Systems Corporation

9 East Stow Road

Marlton, NJ 08053

(609) 983-7300

"Hydrogen Sulfide Principles"

32 Minutes

IHRDC Video Library Sales

535 Boylston Street

~~Boydston~~ Boston, MA 02116

(617) 536-0202

"Hydrogen Sulfide - HazChem 8"

Distributed by Emergency Film Group

1380 Soldiers Field Road

Boston, MA 02135

800-842-0999

~~ANSI Z-390 Hydrogen Sulfide Training Criteria Standards Committee~~

~~American Society of Safety Engineers (Secretariat)~~

~~1800 East Oakton Street~~

~~Des Plaines, IL 60018-2176~~

~~(708) 692-4121~~

B. Other Related Publications

API RP-55 Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

American Petroleum Institute

1220 L Street, NW

Washington, D.C. 20005

(202) 682-8375

ISA RP 12.15 Parts I & II

Instrument Society of America

67 Alexander Drive

P.O. Box 12277

Research Triangle Park, NC 27709

(919) 549-8411

Texas Statewide Rule 36 Hydrogen Sulfide Safety

Texas Railroad Commission

P.O. Box 12967

1701 N. Congress

Austin, TX 78711

(512) 463-7255

29 CFR 1910.134 - Respiratory Protection

29 CFR 1910.146 - Confined Space Entry

29 CFR 1910.252 - Welding Standard

29 CFR 1910.2000 - Hazard Communication

29 CFR 1910.120 - HAZWOPER

29 CFR 1910.20 - Employee Access to Medical Records and Industrial Hygiene Records

H_2S Release Dispersion Modeling References:

The American Society of Safety Engineers, Professional Safety, May 1990. Contains a discussion and listing of dispersion models.

EPA-453/R-93-05 Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, 411 West Chapel Hill Street, Durham, NC 27701. The report may also be obtained from the American Petroleum Industry, Washington, D.C., 202/682-8271

"Casarett and Doull's Toxicology; The Basic Science of Poisons;" Fourth Edition, Pergamon Press.