JUNE 27, 2013

OVERSIGHT OF FEDERAL RISK MANAGEMENT AND EMERGENCY PLANNING PROGRAMS TO PREVENT AND ADDRESS CHEMICAL THREATS, INCLUDING THE EVENTS LEADING UP TO THE EXPLOSIONS IN WEST, TX AND GEISMAR, LA

UNITED STATES SENATE, COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED THIRTEENTH CONGRESS, FIRST SESSION

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Hearings

Statement of Barbara Boxer
Hearing: Full Committee hearing entitled, "Oversight of Federal Risk Management and Emergency Planning Programs to Prevent and Address Chemical Threats, Including the Events Leading Up to the Explosions in West, TX and Geismar, LA"
Thursday, June 27, 2013

Statement of Barbara Boxer
Hearing on Oversight of Federal Risk Management and Emergency Planning Programs to Prevent and Address Chemical Threats, Including the Events Leading Up to the Explosions in West, TX and Geismar, LA
June 27, 2013

What brings us here today is the tragic loss of life and injuries caused by a chemical explosion in West, Texas. After we announced the hearing, another tragic chemical explosion occurred in Louisiana. We must look at why these tragedies and others occur and what we can do to help prevent such disasters.

Let's walk through what happened at West.

On April 17th, a massive explosion and fire destroyed a fertilizer distribution plant and caused widespread destruction. At least 14 people died, hundreds of people were injured, and homes, businesses, and three unoccupied schools were damaged or destroyed.

An owner of a local business said:

"It was like a war zone last night. It's like a nightmare, something you would see in a movie." (Waco Tribune, April 18, 2013)

Just two weeks ago, another deadly tragedy occurred in Louisiana, when more than one hundred people were injured and two workers lost their lives. In that case, a vapor cloud of flammable petroleum gases exploded at a petrochemical refinery, releasing more than 62,000 pounds of toxic chemicals and causing a serious fire.

In August 2012, a failed pipe at a refinery in Richmond, California, released flammable petroleum gases and formed a vapor cloud that ignited. Six workers were injured, and thousands of people from nearby residential areas went to local hospitals for medical treatment.

I want to express my deep condolences to the first responders, workers, and others who lost their lives or were injured in chemical disasters in all these communities and others across the nation.

Federal safety and health officials must use all available tools, including - and most important - updated Risk Management Plans which are required under the law, the best training methods, and new technologies. Lives are at stake and action must be taken now.

Our federal risk management and emergency response laws were written after two tragic disasters in the mid-1980s. In 1984, a facility in Bhopal, India, released a toxic chemical that killed over 2,000 people.

The following year, a facility in West Virginia released thousands of pounds of dangerous chemicals into a nearby community, which sent more than 100 people to the hospital.

In 1986, Congress passed the Emergency Planning and Community Right-to-Know Act to enhance planning to address chemical disasters. And in the 1990 amendments to the Clean Air Act, Congress required risk management planning to help save people's lives at facilities that handle dangerous chemicals.

In the days following the West, Texas, disaster, I wrote to the Chemical Safety Board (CSB) and the Environmental Protection Agency (EPA) requesting information about the explosion, the Risk Management Program, and safeguards under existing law. The CSB replied to me in a letter stating that:

"The CSB considers the West explosion to be among the most serious U.S. chemical incidents affecting the public in many decades." (CSB Letter, May 17, 2013)

This should be a wakeup call for all of us, and we must take steps to ensure that such a disaster never happens again. Here's the good news: under existing law, EPA can strengthen safety at facilities that handle dangerous chemicals.

The CSB has already identified problems that may have contributed to the disaster in West, Texas, including large amounts of combustible material stored in the same areas as wooden containers that hold ammonium nitrate, which can explode when heated.

The CSB also found that the West, Texas, facility was not required to install sprinklers or other fire suppression systems - and that EPA's risk management program does not require special handling for reactive or explosive materials like ammonium nitrate.

I look forward to the CSB's final reports on these recent explosions and to the adoption of any recommendations that CSB makes to help prevent other tragic explosions and loss of life.

According to the CSB, roughly 72 percent of its recommendations have already been adopted. But that means 28 percent of its recommendations have not yet been adopted. EPA, other federal agencies, and industry must act quickly to adopt safety measures that can save lives.

In 2002, the CSB recommended that EPA strengthen the Risk Management Program by including ammonium nitrate and other dangerous chemicals. I want to thank the CSB for its dedicated service and for recognizing the need for action on this issue to protect the American people.

Unfortunately, EPA has not yet acted on CSB's 2002 recommendation. Today I am calling on EPA to adopt this critical safeguard and to report back to me on this request within the next two weeks.

Acting on this safety measure is critically important, because there are thousands of facilities across the nation that handle ammonium nitrate, and we do not know this dangerous chemical and we know this dangerous chemical must be handled safely. If it is, disasters will be avoided.

As we review what happened in the recent explosions, we must make safety the highest priority so that we can enhance protections for workers and other people in our communities.

Local authorities can play a key role in enhancing these safety protections. Mr. Randall Sawyer is here from my home state of California to testify on behalf of the Contra Costa County's Health Department.

I look forward to hearing from him today, as well as the other witnesses, on the steps that EPA, state and local authorities, and industry can take to prevent and eliminate chemical disasters. We don't need new legislation - we need action.

I want to thank Tim White for his heartfelt letter and for his dedication to call for enhanced safety measures so that other families do not have to suffer the same loss his family did.

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Testimony of Rafael Moure-Eraso, Ph.D.
Chairperson, U.S. Chemical Safety Board
Before the U.S. Senate Committee on Environment and Public Works
June 27, 2013

Chairman Boxer, Ranking Member Vitter, and distinguished members of the Committee – thank you for the opportunity to testify before you this morning. I am Dr. Rafael Moure-Eraso, and I am providing this testimony in my capacity as chairperson of the U.S. Chemical Safety Board, or CSB.

The CSB is an independent federal agency that investigates major chemical accidents and hazards, and develops safety recommendations to prevent their recurrence in the future. The Board is a non-regulatory, scientific, investigative agency. It has an annual budget, after the sequester, of $10.6 million and approximately 42 employees. In addition to investigations, safety studies, and recommendations, we do extensive outreach to companies and other organizations to inform them of our findings. Companies throughout the U.S. and the world use the information and recommendations developed by the CSB to help create what we hope are safer workplaces.

Congress frequently calls upon the CSB to investigate the root causes of some of the most complex and tragic industrial accidents across the country. Currently the CSB is involved in investigations of the Deepwater Horizon blowout in the Gulf of Mexico, the 2010 Tesoro refinery fire in Washington State, the 2012 Chevron refinery fire in California, and many other cases. Over the past two months, the CSB has begun investigations of the devastating explosion at West Fertilizer in West, Texas, on April 17, and the June 13 explosion at Williams Olefins in Geismar, Louisiana.

I will summarize the status of these two investigations and our preliminary findings, and then present some general thoughts on how the oversight of chemical safety might be improved.

West Fertilizer

West Fertilizer was a small retail distribution center that served farmers in the surrounding community and had approximately 15 employees. The facility was built in 1961, and at the time of the incident had a handful of buildings, including a warehouse where fertilizers and other materials were stored. The current owner, who operated an adjacent seed business, purchased the facility from liquidation in 2004.

No manufacturing occurred at the site, only blending of fertilizers for retail customers. Fertilizers such as ammonium nitrate and anhydrous ammonia were delivered to the site by rail car or truck. The ammonium nitrate, a granular solid, was stored in the facility's fertilizer warehouse building in wood-framed bins with wooden walls. Both the warehouse building and the bins were constructed of combustible wooden material, and the building also contained significant quantities of combustible materials such as seeds stored near the bins of ammonium nitrate. The building had no automatic sprinkler or fire suppression features.

The facility straddles the city limit in the northeast section of West, Texas. When it was first built, the area was rural and there were few other structures nearby. Over time, many residences, a nursing home, an apartment complex, a high school, and an intermediate school were constructed within a 2000-foot radius of West Fertilizer.

On the evening of April 17, a fire of undetermined origin broke out at the facility, which had already closed for the day and was unattended. At 7:30 p.m. the fire was observed and reported to 9-1-1 dispatchers, who deployed the community's volunteer firefighting force with four pieces of equipment. Firefighters found the warehouse building in flames and were in the process of extending hoses to fight the fire, and were applying some water to the blaze. Although the firefighters were aware of the hazard from the tanks of anhydrous ammonia as a result of previous releases, they were not informed of the explosion hazard from the approximately 60 tons of fertilizer grade ammonium nitrate inside the warehouse.

At about 7:50 p.m., while firefighters were positioned nearby, the ammonium nitrate suddenly detonated. A shock wave, traveling faster than the speed of sound, crushed buildings, flattened walls, and shattered windows. Innumerable projectiles of steel, wood, and concrete – some weighing hundreds of pounds – were hurled into neighborhoods. Twelve firefighters and emergency responders were killed. At least two members of the public died as well. More than 200 were injured. If this incident had occurred earlier in the day, many more people might have been killed or injured.

Residents of the West Rest Haven nursing home were severely affected, and according to nursing home officials 14 patients have passed away since the April 17 explosion, dying at twice the expected rate. The nursing home itself was destroyed, as was the apartment complex across the street. Two large schools – the high school and the intermediate school – were structurally damaged beyond repair and will be torn down, and a third school was also badly damaged. Because of the hour of day, all the schools were unoccupied. Had the explosion taken place during the day, severe casualties could have occurred in the intermediate school, which was devastated by both blast and fire. Post-explosion damage assessments indicate that it would have been difficult for children and others to escape from the building. The CSB is currently evaluating the vulnerability of this structure, to understand the potential consequences if the explosion had occurred when children were present and to inform future siting decisions.

Nearly 200 homes were severely damaged or destroyed, a sizeable fraction of all the houses in West. Financial damage is still being assessed, but the cost to rebuild the schools alone will reportedly approach $100 million. Some reports suggest total damages to the town may exceed $230 million, an unimaginable blow to a town of just 2800 residents – more than $80,000 for each man, woman, and child living in West.

CSB Investigation

A large CSB investigation team was assembled in West the day after the incident, on April 18. To date the CSB has conducted detailed interviews of about 30 witnesses, and has issued approximately 13 document requests to West Fertilizer, contract firms, hospitals, and regulators.

The CSB has also engaged external experts in blast reconstruction, fire codes and fire protection, and explosion mechanisms.

West Fertilizer and other companies have cooperated fully with the investigation. The CSB has also received outstanding cooperation from the mayor of West and its police and fire departments, and from other local agencies. The investigation has faced significant challenges as well, since the accident site was treated as a criminal scene for approximately five weeks after April 17 and was extensively altered during that time period, including the removal of most surviving physical evidence.[1]

I visited West, Texas, on May 2, just a couple of weeks after the explosion. The damage to homes, schools, and businesses was almost beyond imagination – even by the standards of large-scale chemical disasters. My heart goes out to the people of West, as they work to rebuild their proud and historic community. But I can assure you that it will be years before even the physical scars of this terrible explosion begin to fade.

Ammonium nitrate (AN) is a crop nutrient that represents about 2% of the total applied nitrogen fertilizer in the U.S. It is used primarily on pasture and citrus; its use has been declining in recent years as security concerns have increased since the Oklahoma City bombing in 1995. Ammonium nitrate is a strong oxidizer that reacts energetically with organic materials; it is also reactive by itself and capable of a runaway decomposition reaction and detonation under certain conditions.

Ammonium nitrate has historically been involved in some of the most severe chemical accidents of the past century, including disastrous explosions in the United States, Germany, and France. Two of these accidents – in Oppau, Germany, in 1921 and in Texas City, Texas, in 1947 – each killed 500 or more people. Additional safeguards were adopted following the Texas City disaster, such as avoiding contamination with petroleum-based materials that sensitize AN. These changes are credited with reducing the risk of a mass explosion of AN, but the risk of detonation was not eliminated. In September 2001, for example, a large AN explosion occurred at a factory in Toulouse, France, killing 30, injuring thousands of others, and damaging up to 30,000 buildings. Other serious AN-related accidents have occurred in the U.S. and other countries over the years.

Heat, fire, shock, confinement, and contamination are all factors that can sensitize ammonium nitrate to detonation. To quote from a comprehensive 1985 review of the hazards of AN:

> *The main thrust of the safety precautions recommended in most literature is the minimization of the most likely hazard, namely, the risk of fire. Ammonium nitrate should not be stored where it can be affected by any source of heat or by combustible materials.*[2]

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[1] Within the past three weeks, the ATF has begun producing records and evidence from its investigation to the CSB. The ATF released the remains of the West site from its control back to the company on May 24.

[2] Shah, K.D.; Roberts, A.G.; "Safety Considerations in the Processing, Handling, and Storage of Ammonium Nitrate;" In Keleti, C. (ed.); *Nitric Acid and Fertilizer Nitrates*; New York: Marcel Dekker Inc., 1985.

As simple as this sounds, this principle has not been fully adopted across the U.S., and was not implemented at West Fertilizer.

The CSB has made the following observations and preliminary findings to date, which are subject to further revision and development as the investigation unfolds:

1) The explosion at West Fertilizer resulted from an intense fire in a wooden warehouse building that led to the detonation of approximately 30 tons of AN stored inside in wooden bins. Not only were the warehouse and bins combustible, but the building also contained significant amounts of combustible seeds, which likely contributed to the intensity of the fire. According to available seismic data, the explosion was a very powerful event.

2) Whether additional factors such as material characteristics, shock, or contamination contributed to the incident remains to be determined. Company employees described a PVC plastic pipe that was located directly above the AN bin that detonated, and likely would have been melted by the fire. Additionally, large amounts of potentially flammable anhydrous ammonia were stored along the southern edge of the warehouse building.

3) The building lacked a sprinkler system or other systems to automatically detect or suppress fire, especially when the building was unoccupied after hours. By the time firefighters were able to reach the site, the fire was intense and out of control. Just 20 minutes after the first notification to the West Volunteer Fire Department, the detonation occurred.

4) Both National Fire Protection Association (NFPA) and the International Code Council (ICC), private organizations that develop fire codes that are widely applied across the U.S., have written code provisions for the safety of ammonium nitrate. Many of these safety provisions are quite old[3] and appear to be confusing or contradictory, even to code experts, and are in need of a comprehensive review in light of the West disaster and other recent accidents. For example the ICC's International Fire Code directs users to a defunct code for ammonium nitrate (NFPA 490, last issued in 2002) rather than the current code, known as NFPA 400.

5) The existing fire codes do contain some useful provisions; for example the codes do require a fire resistant barrier between AN and any stored flammable or combustible materials and have provisions to avoid AN confinement and promote ventilation during fire conditions. However, even the most current NFPA 400 standard *allows* AN to be stored in wooden buildings and in wooden bins, and does not mandate automatic sprinkler systems unless more than 2500 tons of AN is being stored – vastly more than the approximately 30 tons that was sufficient to devastate much of the town of West. In addition, the standard contains a "grandfathering" provision that allows existing buildings that were constructed prior to code adoption – and fail to meet all of its provisions – to continue in use.

[3] NFPA 400 refers users to a 1953 publication by the U.S. Bureau of Mines for information on the explosive properties of AN.

6) Texas has not adopted a statewide fire code, and state law actually prohibits most smaller rural counties from adopting a fire code. McLennan County, where the West facility was located, had not adopted a fire code, although it technically had the authority to do so because of its proximity to the more populous Bell County. The West Fertilizer facility was thus not required to follow any NFPA or ICC recommendations for the storage of AN.

7) Although some U.S. distributors have constructed fire-resistant concrete structures for storing AN, fertilizer industry officials have reported to the CSB that wooden buildings are still the norm for the distribution of AN fertilizer across the U.S.

8) Industry has developed other forms of ammonium nitrate that are reported to reduce or eliminate the risk of accidental detonation. For example, compounding the ammonium nitrate with calcium carbonate (limestone) "practically eliminates any risk of explosion its storage, transportation, and handling," while preserving the AN's nutritive value.[4] Calcium ammonium nitrate fertilizers have been widely used in Europe. Ammonium sulfate nitrate also has been found to be non-explosive provided the percentage of AN is held below about 37%.[5]

9) The federal OSHA standard for "Explosives and Blasting Agents" (29 CFR 1910.109) does have requirements for ammonium nitrate fertilizer; its provisions are similar to the NFPA codes. Unlike the NFPA codes – which West was not legally required to follow under any fire code – the OSHA standard would have applied. Like NFPA, however, the OSHA standard does not prohibit wooden bins or wooden construction, and does not require sprinklers unless more than 2500 tons of AN is present. However, OSHA public records indicate that OSHA last inspected the facility in 1985, and no citations were issued under the "Explosives and Blasting Agents" standard.

10) OSHA's Process Safety Management standard (29 CFR 1910.119) or PSM was adopted in 1992 and is designed to prevent catastrophic workplace incidents involving highly hazardous chemicals. PSM requires companies to have a variety of management elements to prevent catastrophic incidents, such as conducting hazard analyses and developing emergency plans. Ammonium nitrate is not, however, one of the listed chemicals that triggers PSM coverage. The PSM standard also contains an exemption for retail facilities.

11) The EPA's Risk Management Program rule (40 CFR Part 68) or RMP was adopted in 1996 and is designed to prevent catastrophic offsite and environmental damage from extremely hazardous substances. As the name suggests, the rule requires covered facilities to develop a Risk Management Plan, implement various safety programs, and analyze offsite consequences from potential accidents. Once again, however, ammonium nitrate is not one of the listed chemicals that triggers RMP coverage. West Fertilizer was RMP-covered due to its stored ammonia, and the company's offsite consequence analysis considered only the possibility of an ammonia leak, not an explosion of ammonium nitrate.

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[4] Calcium ammonium nitrate (CAN) must still be protected from contamination with other chemicals that can re-sensitize it to detonation. See Popovici Ipochim, N.N.; Icechim, M.M.; "Other Ammonium Nitrate Fertilizers;" In Keleti, C. (ed.); *Nitric Acid and Fertilizer Nitrates*; New York: Marcel Dekker Inc., 1985.

[5] *Ibid.*

12) OSHA considered adding ammonium nitrate along with other highly reactive chemicals to its list of PSM-covered substances in the late 1990's. However, this proposal was shelved in 2001. In developing the RMP regulation, the EPA did not explicitly include explosives or reactive chemicals in the list of covered chemicals. In 2002, the CSB issued a study on reactive hazards, identifying 167 prior reactive incidents (including a 1994 explosion at an ammonium nitrate manufacturer). The Board recommended that both OSHA and EPA expand their standards to include reactive chemicals and hazards. However, neither agency has yet acted upon the recommendations.

13) No federal, state, or local standards have been identified that restrict the siting of ammonium nitrate storage facilities in the vicinity of homes, schools, businesses, and health care facilities. In West, Texas, there were hundreds of such buildings within a mile radius, which were exposed to serious or life-threatening hazards when the explosion occurred on April 17.

14) West volunteer firefighters were not made aware of the explosion hazard from the AN stored at West Fertilizer, and were caught in harm's way when the blast occurred. NFPA recommends that firefighters evacuate from AN fires of "massive and uncontrollable proportions." Federal DOT guidance contained the Emergency Response Guidebook, which is widely used by firefighters, suggests fighting even large ammonium nitrate fertilizer fires by "flood[ing] the area with water from a distance." However, the response guidance appears to be vague since terms such as "massive," "uncontrollable," "large," and "distance" are not clearly defined. All of these provisions should be reviewed and harmonized in light of the West disaster to ensure that firefighters are adequately protected and are not put into danger protecting property alone.

15) While U.S. standards for ammonium nitrate have apparently remained static for decades, other countries have more rigorous standards covering both storage and siting of nearby buildings. For example, the U.K.'s Health and Safety Executive states in guidance dating to 1996 that "ammonium nitrate should normally be stored in single storey, dedicated, well-ventilated buildings that are constructed from materials that will not burn, such as concrete, bricks or steel."[6] The U.K. guidance calls for storage bays "constructed of a material that does not burn, preferably concrete."

16) CF Industries, a principal manufacturer of AN that was one of the suppliers to West, also recommends more rigorous safeguards in its Material Safety Data Sheet (MSDS) for the chemical. In the section entitled "Handling and Storage," CF recommends that "Storage construction should be of non-combustible materials and preferably equipped with an automatic sprinkler system."[7] Although companies are required to issue MSDS's, the recipients of this information like West Fertilizer are not obligated to follow the recommended safety precautions. West lacked these safeguards.

17) The Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) has regulations for ammonium nitrate used as an explosive but these do not apply to ammonium nitrate used as fertilizer. The U.S. Department of Homeland Security has reporting

[6] U.K. Health and Safety Executive; "Storing and Handling Ammonium Nitrate;" Available from http://www.hse.gov.uk/pubns/indg230.pdf
[7] http://www.cfindustries.com/pdf/Ammonium-Nitrate-Amtrate-MSDS.pdf

requirements for companies that have a threshold amount of fertilizer grade ammonium nitrate. However, the authority of DHS is to require security measures to protect against theft, diversion, or other intentional acts; DHS does not regulate the safety of ammonium nitrate to prevent conditions leading to accidental detonation.

18) The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) contains an exemption from hazardous chemical reporting for "fertilizer held for sale by a retailer to the ultimate customer." The EPA has interpreted this provision as not applying to firms, like West, that make custom blends of bulk fertilizer for customers' use. In 2012, West Fertilizer filed an EPCRA Tier II report with the McLennan County Local Emergency Planning Committee (LEPC). West reported the presence of up to 270 tons of ammonium nitrate, as well as anhydrous ammonia, at the site. The company did not provide the LEPC or the West Fire Department with an ammonium nitrate MSDS indicating the material's hazards, nor does EPCRA automatically require that information to be provided. There is no indication that West's filing with local authorities resulted in an effort to plan for an ammonium nitrate emergency.

It is important to bear in mind the limitations on Local Emergency Planning Committees that operate in communities around the country. While these committees are required to exist under EPCRA, they are largely staffed by either volunteers or local officials who likely have many collateral duties. The law did not establish any funding stream for the LEPC's, and they do not have any regulatory authority over chemical facilities. Their fundamental role is in emergency preparedness and coordination. The primary responsibility for developing and enforcing safety standards belongs to other federal and state agencies.

To summarize, the safety of ammonium nitrate fertilizer storage falls under a patchwork of U.S. regulatory standards and guidance – a patchwork that has many large holes. Specifically, the CSB has not identified any U.S. standards or guidance that prohibit or discourage many of the factors that likely contributed to the West disaster. Combustible wooden buildings and storage bins are permitted for storing AN across the U.S. – exposing AN to the threat of fire. Sprinklers are generally not required unless very large quantities of AN are being stored or fire authorities order sprinklers to be installed. Federal, state, and local rules do not prohibit the siting of AN storage near homes and other vulnerable facilities such as schools and hospitals.

The CSB has had a number of discussions with fertilizer industry representatives since April 17, including officials from The Fertilizer Institute and the Agricultural Retailers Association. We believe the industry has a strong and sincere interest in learning from the tragedy in West and taking steps to prevent future incidents involving ammonium nitrate, including the development of new audit tools and product stewardship programs. I applaud these efforts and encourage these organizations to draw upon the best science as well as the strongest safety recommendations from the U.S. and overseas, to ensure that U.S. fertilizer firms are applying the highest safety standards available anywhere in the world.

These voluntary programs should complement a thorough effort by the federal government to review and improve the comprehensive safety oversight of ammonium nitrate fertilizer distribution. The time for that effort is now.

Williams Olefins Explosion

On June 13, an explosion and fire occurred at the Williams Olefins plant in Geismar, Louisiana. This plant produces ethylene and propylene, which are raw materials for common plastics, and employs over one hundred workers. At the time of the incident, hundreds of contract workers were also present at the site for a major expansion project.

The CSB deployed a team of seven to the site, and CSB investigators have had a continuous presence in Geismar since June 15. The team has interviewed at least 28 witnesses and has reviewed documents and other information obtained from the company. Williams Olefins and other companies at the site have provided excellent cooperation with the investigation.

The incident involved a large distillation tower that processes propylene, propane, and other highly flammable hydrocarbons. The equipment was in normal operation on June 13. At 8:36 a.m. there was a sudden catastrophic failure involving a heat exchanger and associated piping attached to the distillation tower. The steel shell of the heat exchanger ripped open, and piping detached where it connected to the tower. The exact sequence and cause of these events remains to be determined.

In any event, there was a large-scale release of propylene, propane, and other hydrocarbons from multiple release points, forming a vapor cloud more than 200 feet high that is visible in surveillance video from the site. Within four seconds the vapor cloud ignited. Two Williams employees were fatally burned and approximately 105 other Williams employees and contractors were injured. The resulting fire burned for over four hours.

All of us at the CSB offer our deepest condolences and prayers for the families of the victims and for the injured. We are committed to a thorough investigation to determine why this horrible accident occurred.

CSB investigators have surveyed the scene from ground level and from the air, but currently the immediate area of the ruptured equipment remains too hazardous for entry due to overhanging debris. During the course of this week the area will be made safe for human entry, and this will allow investigators to observe the positions of key valves and obtain other important information. In addition we plan to recover and perform metallurgical tests on the heat exchanger and other piping. This testing will help determine whether the equipment that failed had weakened or deteriorated prior to the rupture, or some other factors were at play.

We are also working with the company to recover electronic control system data that will reveal process conditions at the time of the incident, such as material flows, pressures, and temperatures as well as valve positions. These data will also be important to understanding what occurred.

The assessment of the site and equipment is occurring in close coordination with federal OSHA inspectors. Within a few days of the incident, the CSB, OSHA, and the company entered into a written site and evidence control agreement to ensure that the evidence at the site is properly preserved in as-found condition, and all parties participate in the identification and testing of evidence. So far it has been a good model for how all incident sites should be handled.

CSB Investigative Capacity

The recent tragedies in West and Geismar have further taxed the CSB's already overstretched staffing and resources. When the Congress requested that the CSB conduct a root-cause investigation of the Deepwater Horizon blowout, we informed Congress that this vital work would have unavoidable adverse effects on many other cases the CSB had already begun. The CSB already faced a record backlog of cases in 2010, when I became the chair. Not only have these adverse effects occurred, but Transocean – the operator of the Deepwater Horizon – has engaged in a lengthy legal challenge to the CSB's authority to investigate the incident. On April 1, 2013, a federal district court in Houston ruled completely in the CSB's favor and confirmed our offshore jurisdiction, but Transocean has indicated its intention to appeal the decision and seek a stay of enforcement. This unfortunate legal situation has continued to delay the CSB's access to many documents and witnesses relevant to the investigation of the blowout.

The West and Geismar investigations have very significant financial costs associated with them and West in particular has required the diversion of a very large percentage of CSB's investigators, who already had many months of work in the pipeline ahead of them when the tragedy struck. I would like to engage in a discussion with the Committee over the coming weeks about the impact of these new investigations on the CSB's capacity to finish existing investigations – many of which have important stakeholders who have already been waiting a long time for answers. I also wish to notify the Committee that I believe the CSB has no capacity at this point to undertake any new investigative work, beyond what has already been promised and begun.

Possible Approaches for Reducing Risk

Since the CSB was established in 1998, the Board has made a number of safety recommendations for improving the oversight of facilities that handle hazardous substances. The CSB has made a number of recommendations to the Environmental Protection Agency, including the above-mentioned recommendation to broaden the application of the Risk Management Program to encompass reactive hazards that could have an impact on communities. The CSB has also recently recommended that the EPA strengthen the safety provisions for disposing of hazardous waste; this followed a recent tragedy in Hawaii where five federal subcontractors were killed disposing of illegal fireworks seized by the government.

In another recent case, the CSB urged the EPA to make greater use of its general duty clause authorities under the Clean Air Act by warning operators of their responsibility to safeguard remote oil and gas production sites; the CSB investigation found that 44 members of the public – children and young adults – died in explosions at these unsecured hazardous sites.

The Board has made a number of safety recommendations to OSHA as well. Among the improvements we have sought are a new regulatory standard for combustible dust; broadening the PSM standard to cover reactive chemicals and atmospheric storage tanks and to require more effective management of change reviews; modernization of standards for acetylene and compressed gases; and developing a new safety standard for fuel gases.

The majority of the CSB's recommendations have not been directed to federal regulators but rather to other organizations around the country, including state and local governments, labor unions, trade associations, and the bodies like the ICC and NFPA that are responsible for developing consensus standards. The overall acceptance rate for CSB recommendations now exceeds 70%, and we track all recommendations to completion.

Improved enforcement efforts are just as important as having effective standards. In the CSB's 2007 report on the explosion at BP's Texas City refinery, the Board called for OSHA to expand its enforcement of process safety requirements by "hiring or developing a sufficient cadre of highly trained and experienced inspectors." The Board report observed that there were few comprehensive OSHA inspections of refineries and other chemical sites, and OSHA had only a handful of inspectors with industrial process experience. By comparison, other countries like the U.K. had developed large bodies of specialized inspectors to perform ongoing, detailed safety inspections of hazardous facilities. OSHA responded in part to the recommendation by creating a new National Emphasis Program for refineries; the program was considered very effective by OSHA leaders, uncovering many safety problems in refineries. Unfortunately, OSHA did not have adequate resources to continue the program for more than a temporary period.

The EPA has also lacked the dedicated resources to conduct extensive enforcement of RMP program requirements. When this Committee conducted oversight of the program in 2007, the EPA told the late Senator Lautenberg that the total RMP-related fines collected for the entire country over nearly a four-year period (from fiscal year 2004-2007) were just over $3.5 million,[8] a modest sum for a program that covers over 12,000 facilities.

The CSB believes there are a number of serious challenges for improving industrial process safety in the U.S. As noted above, both OSHA and EPA process safety standards rely heavily upon list-based approaches for determining which facilities and companies have to comply with the most rigorous requirements. This concept of a hazardous chemical list was largely borrowed from environmental statutes of the 1970's and 1980's. However, process safety experts generally recognize that process hazards are a function of chemistry itself, and it makes little sense to assert that the overall risks from chemical processing and handling can be adequately captured using small lists of chemicals. Time and again the CSB has found large chemical hazards – capable of causing major disasters – residing in facilities that have largely escaped regulatory scrutiny. These facilities – of which West Fertilizer is but one example – fall outside the scope of existing regulatory standards, which were developed in the 1990's and have seen few updates since then. All too often, a tragedy like the one at West suddenly exposes the hazards of a chemical or process that had somehow been overlooked.

The effects of these regulatory and enforcement challenges are evident in the accident rates for U.S. refineries and petrochemical sites. In 2008, a leading reinsurance company, Swiss Re, told the CSB and federal regulatory agencies that property losses from U.S. refinery accidents were occurring at approximately four times the rate of the rest of the world. In a follow-up briefing, Swiss Re officials asserted the gap between refinery safety performance in the U.S. and in the

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[8] Christopher P. Bliley, Associate Administrator, EPA; Letter to Senator Barbara Boxer, Chairman, Committee on Environment and Public Works, August 22, 2007.

rest of the world was continuing to widen. Many developed nations have adopted a different approach for controlling major process hazards. For example, nations in Europe and elsewhere have implemented a "safety case" regime, that requires hazardous facilities to continuously meet higher standards and reduce risk. Companies work directly with the regulator to identify the most appropriate safety standards from around the world, which they then are required to follow as a condition of operating. The focus is on preventing accidents in highly complex, technological systems rather than post-accident punishment.

Implementing an effective regulatory regime such as the safety case, with the ability to manage and regulate high hazard industries and prevent serious accidents, requires a number of inter-dependent features. First, the regulatory regime must be truly goal-setting in nature; another term for this is a performance-based regulatory regime. This approach provides industry the opportunity to tailor the regulations to its specific facilities with the goal of continuous risk reduction and incident prevention. The safety case regime also imposes a general duty on industry to reduce all risks in its operations to as low as reasonably practicable (ALARP). Such an approach places the impetus on industry to evolve with current best safety practices, wherever they have been developed anywhere in the world, to ensure that process hazards have been adequately identified, evaluated, and controlled. Furthermore, this regime requires industry to utilize leading and lagging indicators to drive risks involved in major hazard facilities to as low as reasonably practicable. Finally, for effective implementation, this type of regime requires an independent, competent, and well-funded regulator. Experience and competence in technical areas such as chemical engineering, human factors, and process safety management are necessary to provide effective auditing and regulatory oversight for prevention. In a recent federal OSHA forum on reforming process safety regulations, noted safety expert Andrew Hopkins pointed out that all of these elements are essential for an effective major accident prevention regime. Dr. Hopkins emphasized that the whole package of the safety case system needs to be introduced to make it work, including a competent, well-funded regulator.[9]

The CSB has begun to examine these alternative regulatory systems in the context of investigating the recent Chevron refinery fire in California and the Deepwater Horizon blowout in the Gulf. This April, the CSB issued its interim report on the Chevron refinery fire, which sent over 15,000 Richmond residents to the hospital in August 2012. California legislators have responded proactively to the accident and to the CSB's recent findings and recommendations. A bill now before the California governor for signature would effectively triple the number of dedicated process safety inspectors in the state. This expansion will be funded by fees collected from the industry, and will not significantly burden taxpayers. And state legislators as well as leaders from Contra Costa County, where the refinery is located, have been working to implement other CSB recommendations for safer equipment designs and materials, reporting of process safety indicators, and improved maintenance procedures. California's actions should be closely examined, we believe, as a potential model for other states and the federal government to follow.

Thank you again, Chairman Boxer and Ranking Member Vitter, for the opportunity to testify today.

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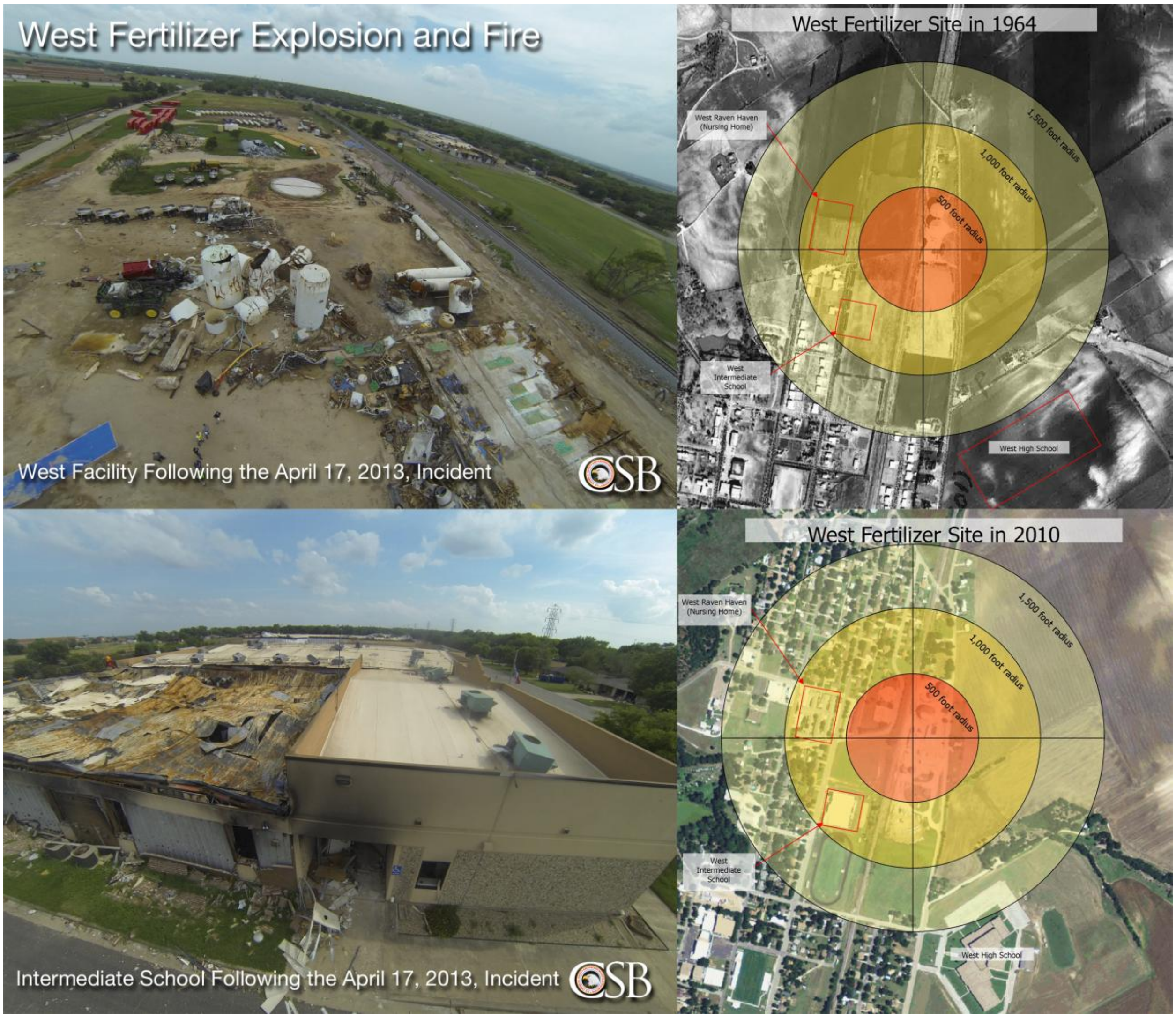
[9] OSHA Expert Forum on the Use of Performance-Based Regulatory Models in the U.S. Oil and Gas Industry, Offshore and Onshore; Texas City, Texas; September 20, 2012.


West Fertilizer Explosion and Fire
West Facility Following the April 17, 2013, Incident
West Fertilizer Site in 1964
West Raven Haven (Nursing Home)
1,500 foot radius
1,000 foot radius
500 foot radius
West Intermediate School
West High School
Intermediate School Following the April 17, 2013, Incident
West Fertilizer Site in 2010
West Raven Haven (Nursing Home)
1,500 foot radius
1,000 foot radius
500 foot radius
West Intermediate School
West High School


Photos from the June 13, 2013,
Williams Olefins Incident
Geismar, LA


CSB

TESTIMONY OF
BARRY N. BREEN
PRINCIPAL DEPUTY ASSISTANT ADMINISTRATOR
OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

June 27, 2013

Good morning Chairman Boxer and members of the Committee, I am Barry Breen, Principal Deputy Assistant Administrator for the U.S Environmental Protection Agency's Office of Solid Waste and Emergency Response. Thank you for the opportunity to testify today on the EPA's Risk Management Program and emergency planning and community right-to-know issues.

West, Texas Facility and Geismar, LA Incidents

On April 17, 2013, a fire and explosion occurred at the West Fertilizer plant in the town of West, Texas, causing multiple injuries and fatalities. The explosion shock wave caused multiple fires within a six block radius. The EPA responded as part of a multi-agency effort, including the U.S. Chemical Safety Board (CSB), the Federal Bureau of Alcohol Tobacco and Firearms (ATF), the Texas Commission on Environmental Quality (TCEQ), and Texas Fire Marshal Office. As part of the EPA's role, the agency conducted air monitoring using both stationary sites and a mobile monitoring team in the neighborhoods west of the facility. The EPA monitored for airborne contaminants including volatile organic compounds, ammonia, carbon monoxide, and lower explosive limits of methane gas. The EPA also deployed emergency response personnel to the site of the explosion and fire at the Williams Olefin facility in Geismar, LA. The agency is conducting its post-accident assessment efforts in coordination with the other federal, state and local agencies for both incidents.

The Emergency Planning and Community Right-To-Know Act

In response to the devastating chemical disaster in Bhopal, India in 1984, Congress passed the Emergency Planning and Community Right-to-Know Act (EPCRA) in 1986 to ensure that local communities have the authority they need to prevent, prepare for, and respond to chemical accidents. The EPCRA provisions help increase local planners, responders, and the public's knowledge and access to information on chemicals at individual facilities and risks associated with them. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment. The implementing regulations for emergency planning, emergency release notification, and the chemicals subject to these regulations are codified in 40 CFR part 355. The implementing regulations for community right-to-know reporting (or hazardous chemical reporting) are codified in 40 CFR part 370.

Subtitle A of EPCRA establishes the framework for local emergency planning. The Act requires that the EPA publish a list of extremely hazardous substances (EHSs). The EHS list was established by the EPA to identify chemical substances that could cause serious irreversible health effects from accidental releases {(See 40 CFR part 355 (52 FR 13378, April 22, 1987)}. The Agency was also directed to establish a threshold planning quantity (TPQ) for each extremely hazardous substance.

The purpose of the EHSs list is to focus initial efforts in the development of state and local contingency plans. Inclusion of a chemical on the EHSs list indicates a need for the community to undertake a program to investigate and evaluate the potential for accidental exposure associated with the production, storage or handling of the chemical at a particular site and develop a chemical emergency response plan around those risks.

Under EPCRA section 302, a facility that has an EHS on-site in excess of its TPQ must notify the State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC), as well as participate in local emergency planning activities. Under the Statute, the LEPC shall then develop a community emergency response plan. Emergency Response plans contain information that community officials can use at the time of a chemical accident.

The EPA and the National Oceanic and Atmospheric Administration (NOAA) have developed a system of software applications used widely by States and local emergency planning committees to plan for and respond to chemical emergencies. This system is called the Computer-Aided Management of Emergency Operations (CAMEO) and it was developed to assist front-line chemical emergency planners and responders. Emergency responders and planners use CAMEO to access, store, and evaluate information critical for developing emergency plans. In addition, CAMEO supports regulatory compliance by helping users meet the chemical inventory reporting requirements of EPCRA. The CAMEO system integrates a chemical database and a method to manage the data, an air dispersion model, and a mapping capability. All modules work interactively to share and display critical information in a timely fashion.

Subtitle B of EPCRA established community right-to know requirements in order to ensure information on chemicals in the community is provided to the public as well as emergency responders. Under ECPRA sections 311 and 312, facilities that have either (1) a hazardous chemical present at or above 10,000 pounds or (2) an EHS present at or above its TPQ or 500 pounds—whichever is the lesser, are required to submit an Emergency and Hazardous Chemical Inventory form (Tier II) and a Material Safety Data Sheet (MSDS) for that chemical to their SERC, LEPC and local fire department. A chemical is hazardous as defined under the Hazard Communication Standard (HCS) of the Occupational Safety and Health Act (OSHA). There is not a separate list of hazardous chemicals. If a facility is required by OSHA to develop and/or maintain a MSDS for that chemical and it is present at or above the threshold discussed above, it must be reported. Local fire departments receive this information and should use it to understand the chemical(s) present at facilities in their community and precautions they may need to take in responding to an accident at the facility.

Sections 311 and 312 of EPCRA make available to the local and state emergency planners information on other chemicals and facilities, beyond those identified under section 302, that they may wish to include in their emergency planning efforts. The EPA has specified in guidance that Tier II information under section 312 will provide specific information on the quantities and locations of hazardous chemicals. Thus, sections 311 and 312 provide information supportive of the emergency planning required under Subtitle A. The facilities identified as a result of that subtitle are only a "first cut" of the facilities and potential chemical hazards for which emergency planning may be necessary.

Risk Management Program

The Clean Air Act (CAA) 112(r) provisions build on the planning and preparedness groundwork laid by EPCRA. CAA 112(r) provides the authority for the EPA's Risk Management Program (RMP). RMP regulations apply to the owner or operator of a stationary source with more than a threshold quantity of a CAA section 112(r) regulated substance in a process. Section 112(r) chemicals and thresholds may overlap with chemicals listed under other rules, but are not identical to those on any other list. The section 112(r) list includes 63 flammable gases and liquids and 77 acutely toxic chemicals. To develop the list, several statutory factors were considered, including the severity of any acute adverse health effects associated with accidental releases of the substance, the likelihood of accidental releases of the substance, and the potential magnitude of human exposure to accidental releases of the substance. An accidental release is an unanticipated emission of a regulated substance or other extremely hazardous substance into the ambient air from a stationary source. Many of these substances are also included on the EPCRA extremely hazardous substance (EHS) list.   The section 112(r) chemical list and corresponding thresholds for each chemical are published at 40 CFR 68.130. Under CAA section 112 (r), the EPA is required to review the list of chemicals every 5 years or by its own motion or by petition. The EPA also provides an ongoing review of new chemicals and hazards to see if any chemical warrants listing or delisting.

Under the RMP regulations, a covered facility is required to review the hazards associated with the covered substance, process and procedures, as well as develop an accident prevention program and an emergency response program. The "Hazard Review" must identify opportunities for equipment malfunction or human error that could in turn cause the accidental release of the covered substance, as well as safeguards to prevent the potential release, and steps to detect and monitor for a release. A facility's compliance with these requirements is documented in a Risk Management Plan that is submitted to the EPA. Covered facilities must implement the Plan and update them every 5 years or when certain changes occur. The goal of the EPA's Risk Management Program is to prevent accidental releases of substances to the air that can cause serious harm to the public and the environment from short-term exposures, and to mitigate the severity of releases that do occur. Approximately 12,800 facilities are currently covered under Risk Management Program regulations.

Under the CAA section 112(r) RMP facilities must submit a risk management plan which includes:

- Facility hazard assessments, including worst-case release and alternative release scenarios;
- Facility accident prevention activities, such as use of special safety equipment, employee safety training programs, and process hazards analyses conducted by the facility;
- Past chemical accidents at a facility; and
- Facility emergency response programs and plans.

Another key component of Section 112(r) of the Clean Air Act, is section 112(r)(1), which is the General Duty Clause. This provision requires owners and operators of any stationary sources producing, processing, handling or storing an RMP substance or any other extremely hazardous substance to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which may occur. This requirement is all encompassing and is used proactively to prevent accidents when hazards are observed that could lead to a chemical accident, or after an accident, if a facility failed to properly carry out this statutory requirement. Under the General Duty, facilities are expected to comply with recognized and generally accepted good engineering practices.

Both EPCRA and the CAA section 112(r) Risk Management Program encourage communication between facilities and the surrounding communities about chemical safety and chemical risks. Regulatory requirements, by themselves, will not guarantee safety from chemical accidents. Those who are handling hazardous substances must take the responsibility and act to prevent, prepare for and respond to chemical emergencies. Information about hazards in a community will allow local emergency officials and the public to work with industry to prevent accidents.

Conclusion

The EPA will continue its efforts to help prevent chemical accidents and releases under the Risk Management Program. Strong chemical accident prevention, preparedness, and response programs rely upon effective partnerships with the public and all levels of government. We will continue our outreach efforts to stakeholders and work with our federal, state, and local partners to promote chemical safety, address chemical process safety issues, and explore opportunities for improving chemical safety.

Written Testimony of Randall L. Sawyer
Chief Environmental Health and Hazardous Materials Officer – Contra Costa Health Services
Hearing on "Oversight of Federal Risk Management and Emergency Planning Programs to Prevent and Address Chemical Threats, Including the Events Leading up to the Explosions in West, TX and Geismar, LA"
Before the Committee on Environment and Public Works
United States Senate
June 27, 2013

Chairman Boxer, Ranking Member Vitter, and Honorable Members of the Committee:

Thank you for inviting me to participate in today's hearing. My name is Randy Sawyer.

Contra Costa County is located on the San Francisco Bay estuary. Contra Costa County is the home to four petroleum refineries and many small to medium chemical facilities. Many accidental releases, spills and fires from these facilities impacted the employees of these facilities and the surrounding communities during the 1990s. There was an average of one accident a year that resulted in a release or fire that caused the death of workers or had a major impact to the community. Members of the community, labor unions and the County's Board of Supervisors looked for solutions to this problem. Two major changes to how the County, the City of Richmond, and industry operated occurred during this time. First was installation of the most integrated warning system in the Country and the second was implementation of the most encompassing accidental release prevention program in the Country.

History

Major Chemical Accidents and Releases

Below is a listing of major accidents and releases that occurred in the County during the 1990s.

- May 1992 lube spent acid was released and ignited and one worker died and another was seriously injured and there was a major impact from the smoke and gas cloud that was formed.
- August 1993 four to eight tons of sulfur trioxide was released that reacted with the water in the air to produce a sulfuric acid cloud and more than 20,000 people sought medical attention.
- September 1994 there was a release that occurred over 16 days that impacted the workers at the refinery and the surrounding community where more than 1,200 people sought medical attention at a special clinic established as a result of this release.
- June 1995 there was a crude unit fire where the refinery established alternative housing at a motel during and after the fire for more than 100 families.

- April 1996 there was a major release and fire at a catalytic gas unit that caused millions of dollars of damage at the facility and impact to the surrounding community from the fire smoke.
- May 1996 there was an accidental release of hot coke[1] that ignited and caused millions of dollars of damage at the facility.
- January 1997 there was a runaway reaction at a hydrocracker unit, which caused increased temperatures and pressures and the outlet piping from the hydrocracker failed, killing one worker and injuring 46 contractor employees.
- February 1999 there was a flash fire at a crude unit where four employees died and one was seriously injured.
- March 1999 a six-inch valve failed at a gasoline process unit and a gas release occurred that exploded and ignited, causing millions of dollars of damage to the facility and smoke impacting the surrounding community.

There was an accident that occurred at a non-chemical or petroleum refinery in which there was a dust explosion, resulting in the death of a worker and major damage at the facility.

Community Warning System

The County looked at how to alert and notify the surrounding community around an industrial site if there was a release or fire from the site that could impact the community. The original concept was to develop local Traveler Information System radio stations, which could broadcast local emergency information; a telephone emergency notification system, which would call people with land lines downwind of a release; work with a local radio station to broadcast emergency information within Contra Costa County; and consider adding sirens in the industrial area of the County. After the 1993 release of sulfur trioxide, when more than 20,000 people sought medical attention, a committee was formed including eight community members, four industrial representatives, and three representatives from law enforcement, fire and health services to determine the best means available to alert and notify the community during an incident. The committee visited industrial sites in Texas and Louisiana and met with warning system consultants to determine the best means to alert and notify the community as quickly and thoroughly as possible. The committee developed a report that looked at an "All Hazard" warning system, which they submitted to the County's Board of Supervisors in December 1993. The County accepted the report and created a Community Notification Advisory Board.

The Community Notification Advisory Board worked with the Contra Costa County Community Awareness and Emergency Response (CAER) Group to design and find funding for the final project. The Community Notification Advisory Board developed a means for funding to be paid for from the industries that handled acutely hazardous

[1] Coke is a petroleum byproduct of some refineries. Coke is similar to coal. A delayed coker is one type of equipment that is used to produce this coke. The coke is formed in a delayed coker at high temperatures and then cooled. When the coke is cooled it is then dropped from the coker to a containment area below the delayed coker. This accident occurred when the coke was dropped before it was cooled properly, which caused a major fire.

materials. A project manager was hired by CAER to oversee the project to completion. The final system includes activation computer terminals at the four refineries and two chemical facilities. The system can be activated with a push button from these six industrial sites that will sound sirens in the surrounding community, notify emergency response agencies, alert the surrounding community by broadcasting over the National Weather Service, activate the Emergency Alert System, send messages to the media using the California Emergency Digital Information System and Twitter accounts and call the community within 1,000 yards of the boundary of the community. The telephone area is modified, if needed, when the wind direction is known and people who have registered their cell phones are called and/or receive a text message and/or an e-mail message. Now virtually all smart cell phones in the County will be alerted by a text messages when there is an incident. The message will state where the incident is occurring and what protective actions are being given. County staff can activate different scenarios throughout the County anywhere they have computer access to the internet. There are also four locations where scenarios are programmed into dedicated terminals at the Contra Costa Health Services Hazardous Materials Programs, the Office of the Sheriff's Dispatch Center, the Office of the Sheriff's Community Warning System Offices, and the Contra Costa County Fire Protection District Dispatch Center. There are also terminals that can receive information automatically at four other City Police Departments Dispatch Centers, the California Highway Patrol Bay Area Dispatch Center, the Bay Area Air Quality Management District's offices, and the San Ramon Valley Fire Protection District Dispatch Center. There is also a public website that the public can access to find out information on the incident, including the area that we are asking people to shelter in place. The original system was paid for by industry and given to the County in June 2001. There are three other notification levels that were developed and are detailed in the County's Hazardous Materials Incident Notification Policy that can be found at the following web address: http://www.cchealth.org/groups/hazmat/pdf/incident_notification_policy.pdf. The Notification Policy describes the Community Warning System and when and at what level to notify the Contra Costa Health Services Hazardous Materials Programs.

Accident Prevention Programs

California passed one of the first accidental release prevention programs in the United Sates in 1986, which was called the Risk Management and Prevention Program. Contra Costa County started implementing this program in 1989. This program was a predecessor to the U. S. EPA Risk Management, OSHA's Process Safety Management, and the California Accidental Release Prevention Programs. If a facility handled some of the more toxic chemicals, which were called acutely hazardous materials, above a threshold they were required to develop and implement a Risk Management and Prevention Plan. In Contra Costa County, there was a 46% decrease in the highest amount of acutely hazardous materials that was handled between 1990 and 1994 to the amount of acutely hazardous materials that were handled at the end 1994 if sulfuric acid was not included. There were three chemical engineers with industrial experience who worked implementing this program in 1992 when Contra Costa County began auditing the regulated businesses for compliance with the law.

On January 1, 1997 California adopted the U.S. EPA's Risk Management Program and made it more stringent by adopting some of the requirements of the Risk Management and Prevention Program. The regulated communities that were required to submit a Risk Management Plan to the U.S. EPA by June 1999 were also required to submit a Risk Management Plan to the local Unified Program Agency. There were additional California-only regulated sources that were required to submit Risk Management Plans three years after the local Unified Program Agency requested them.

Because of the accidents that occurred in Contra Costa County during the 1990s, the community and the County's Board of Supervisors wanted a more stringent accidental release prevention program than California's, U.S. EPA or the Federal OSHA accidental release prevention programs. The County originally adopted what was called the "Good Neighbor" ordinance. This ordinance had some major faults and some of the petroleum refineries filed a lawsuit to stop its implementation. While the lawsuit was going through the court system, industry, the Paper, Allied Chemical, and Energy labor Union, and the County worked at finding an alternative to the "Good Neighbor" ordinance.

Industrial Safety Ordinance

In December 1998, the County replaced the "Good Neighbor" ordinance with the Industrial Safety Ordinance for facilities in the unincorporated areas of the County that became effective on January 15, 1999. Two years later, the City of Richmond adopted this ordinance for facilities in that City.

The Board of Supervisors passed the Industrial Safety Ordinance because of accidents that occurred at the oil refineries and chemical plants in Contra Costa County. The ordinance applies to oil refineries and chemical plants with specified North American Industry Classification System (NAICS) codes that were required to submit a Risk Management Plan to the U.S. EPA and are program level 3 stationary sources as defined by the California Accidental Release Prevention (CalARP) Program. The ordinance specifies the following:

- Stationary sources had one year to submit a Safety Plan to Contra Costa Health Services stating how the stationary source is complying with the ordinance, except the Human Factors portion.
- Contra Costa Health Services develop a Human Factors Guidance Document (completed January 15, 2000).
- Stationary sources had one year to comply with the requirements of the Human Factor Guidance Document that was developed by Contra Costa Health Services.
- For major chemical accidents or releases, the stationary sources are required to perform a root cause analysis as part of their incident investigations.
- Contra Costa Health Services may perform its own incident investigation, including a root cause analysis.
- All of the processes at the stationary source are covered under the Industrial Safety Ordinance requirements.
- The stationary sources are required to consider Inherently Safer Systems for new processes or facilities or for mitigations resulting from a process hazard analysis.

- Contra Costa Health Services will review all of the submitted Safety Plans and audit/inspect all of the stationary source's Safety Programs within one year of the receipt of the Safety Plans (completed January 15, 2001) and every three years after the initial audit/inspection.
- Contra Costa Health Services will give an annual performance review and evaluation report to the Board of Supervisors.

The 2006 amendments to the Industrial Safety Ordinance require or expand the following:

1. Expand the Human Factors to included Maintenance and all of Health and Safety
2. Require the stationary sources to perform Safety Culture Assessments one year after the Hazardous Materials Programs develops guidance on the performing a Safety Culture Assessment (Safety Culture Assessment Guidance was completed November 9, 2009)
3. Perform Security Vulnerability Analysis

The seven stationary sources now covered by the County's Industrial Safety Ordinance are:

1. Air Products at the Shell Martinez Refining Company
2. Air Products at the Tesoro Golden Eagle Refinery
3. Shell Martinez Refining Company
4. General Chemical West in Bay Point
5. Phillips 66 Rodeo Refinery
6. Tesoro Golden Eagle Refinery
7. Air Liquidé Large Industries

The City of Richmond Industrial Safety Ordinance became virtually identical to the County's Industrial Safety Ordinance when the City of Richmond adopted the County's 2006 amendments in February 2013. Two stationary sources are covered by the City of Richmond's Industrial Safety Ordinance:

1. Chevron Richmond Refinery
2. General Chemical West in Richmond

Human Factors Guidance

Regulated Sources are required to develop comprehensive human factors programs to include operations, Health & Safety, and maintenance departments. Comprehensive human factors programs must develop methods for evaluating and resolving active failures and latent conditions initiated within the following four dimensions or at the interfaces between the dimensions:

- Individuals (e.g., motivation, emotional states)
- The activity or task being conducted, including the procedures for the activity or task (e.g., routine, non-routine, written, practice, formal, informal)
- The physical environment (e.g., equipment) or workplace
- Management or organization (e.g., poor communication, reward and discipline system)

The goal of the guidance document is to develop the requirements from the Industrial Safety Ordinance to ensure that sources will evaluate and resolve failures and conditions initiated within the previous four dimensions. Stationary sources must identify potential unsafe acts or active failures occurring in hazardous circumstances. They must also assess the adequacy of their existing safeguards and incorporate improvements if necessary. Both of these requirements can be fulfilled by conducting traditional and possibly procedural process hazard analyses. When incidents and accidents do occur, sources must perform incident investigations to identify the active failures and existing latent conditions that contributed to the incident. The latent conditions[2] identified during the incident investigation must be incorporated into a program developed to manage and control latent conditions. Other programs must also be developed and implemented to manage and control latent conditions including a Management of Change[3] procedure to review staffing changes, a program for developing high quality procedures, and a program for developing a sound management system. Minimization of latent conditions should result in fewer unsafe acts or active failures or at least reduced risk from the unsafe acts and active failures that do occur.

Management of Organizational Change

The Human Factors section of the Industrial Safety Ordinance requires stationary sources to conduct a Management of Change prior to staffing changes that affect permanent staffing levels/reorganization in operations or emergency response. Employees and their representatives shall be consulted in the Management of Change. Stationary sources may elect to develop a separate Management of Change procedure for staffing changes. Primarily, the guidance document details requirements for identifying the technical basis for the organizational change and assessing the impact of the organizational change on safety and health. The requirements specified in the guidance document apply to:

- Reduction in the number of positions or number of personnel within those positions in operations, including engineers and supervisors with direct responsibilities in operations; positions with emergency response duties; and positions with safety responsibilities.
- Substantive increase in the duties in operations, including engineers and supervisors with direct responsibilities in operations; positions with emergency response duties; and positions with safety responsibilities (e.g., addition of equipment or instrumentation which significantly adds to the complexity of the system).

[2] Latent conditions are underlying conditions that can lead to an accident when an action combines with the underlying condition.
[3] Management of Change is a term that is used in the U. S. EPA Risk Management and Federal OSHA's Process Safety Management Programs referring how a facility manages change in the process units and in their processes safely programs and ensuring that affected personnel are trained on the change.

- Changes in the responsibilities of positions in operations, including engineers and supervisors with direct responsibilities in operations; positions with emergency response duties; and positions with safety responsibilities.

Each stationary source must develop criteria or guidance to assist appropriate personnel in determining "when" a Management of Change for an organizational change should be initiated.

Root Cause Analysis

The primary purpose of an incident investigation is to prevent reoccurrence through the identification and correction of the causal factors of the incident. The process of determining of the causal factors seeks to answer the basic questions about an incident:

- What happened?
- How did it happen?
- Why did it happen?

A root cause analysis is a systematic process that determines the causal factors, i.e., the events and conditions that are necessary to produce or contribute to an incident. The analysis develops what happened and how it happened, and then focuses on finding the underlying causes for why an incident happened by determining the causal factors of an incident. There are three types of causal factors:

- Direct cause
- Contributing causes
- Root causes

The direct cause of an incident is the immediate events or conditions that caused the incident. The direct cause addresses what happened. Contributing causes address how and why an incident happened. Contributing causes are causal factors that are events or conditions that collectively with other causes increase the likelihood of an incident but that individually did not cause the incident. The identification of root causes answers the question of why an incident happened. Root causes are the causal factors that if corrected, would prevent recurrence of the incident. Root causes can include system deficiencies, management failures, inadequate competencies, performance errors, omissions, non-adherence to procedures and inadequate organizational communication. Root causes are generally the result of a management system failure. Root causes can be found at more than one level of an organization from management down through the first-line supervisors.

Root causes may be found at the worker level. However, Contra Costa Health Services agrees with the guideline set forth in the Department of Energy Accident Investigation Workbook that a root cause of an accident can be found at the worker level if, and only if, the following conditions are found to exist:

- Management systems were in place and functioning, and provided management with feedback on system implementation and performance

- Management took appropriate actions based on the feedback
- Management, including supervision, could not reasonably have been expected to take additional actions based on their responsibilities and authorities.

Inherently Safer Systems

The intent of the Inherently Safer Systems requirements is that each stationary source, using good engineering practices and sound engineering judgment will incorporate the highest level of reliable hazard reduction to the greatest extent feasible, to prevent Major Chemical Accidents and Releases[4].

"Inherently Safer Systems (ISS) means Inherently Safer Design Strategies as discussed in the 2008 Center for Chemical Process Safety Publication "Inherently Safer Chemical Processes" and means feasible alternative equipment, processes, materials, lay-outs, and procedures meant to eliminate, minimize, or reduce the risk of a Major Chemical Accident or Release by modifying a process rather than adding external layers of protection. Examples include, but are not limited to, substitution of materials with lower vapor pressure, lower flammability, or lower toxicity; isolation of hazardous processes; and use of processes which operate at lower temperatures and/or pressures."[5] "For all covered processes, the stationary source shall consider the use of inherently safer systems in the development and analysis of mitigation items resulting from a process hazard analysis and in the design and review of new processes and facilities."[6] The term inherently safer implies that the process is safer because of its very nature and not because equipment has been added to make it safer.[7]

2008 Center for Chemical Process Safety Publication Inherently Safer Chemical Processes has defined four categories for risk reduction:

- Inherent - Eliminating the hazard by using materials and process conditions which are nonhazardous; e.g., substituting water for a flammable solvent.
- Passive - Minimizing the hazard by process and equipment design features that reduce either the frequency or consequence of the hazard without the active functioning of any device; e.g., the use of equipment rated for higher pressure.

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[4] County Ordinance Code Section 450-8014(h) Major Chemical Accident or Release means an incident that meets the definition of a Level 3 or Level 2 incident in the Community Warning System incident level classification system defined in the Hazardous Materials Incident Notification Policy, as determined by Contra Costa Health Services; or results in the release of a regulated substance and meets one or more of the following criteria:

- Results in one or more fatalities
- Results in greater than 24 hours of hospital treatment of three or more persons
- Causes on- and/or off-site property damage (including cleanup and restoration activities) initially estimated at $500,000 or more. On-site estimates shall be performed by the regulated stationary source. Off-site estimates shall be performed by appropriate agencies and compiled by Health Service
- Results in a vapor cloud of flammables and/or combustibles that is more than 5,000 pounds

[5] County Ordinance Code Chapter 450-8, §450-8.014(g)

[6] County Ordinance Code Section 450-8.016(D)(3)

[7] Process Plants: A Handbook for Safer Design, 1998, Trevor Kletz

- Active – Using controls, safety interlocks and emergency shutdown systems to detect and correct process deviations; e.g., a pump that is shut off by a high-level switch in the downstream tank when the tank is 90% full. These systems are commonly referred to as engineering controls.
- Procedural – Using operating procedures, administrative checks, emergency response and other management approaches to prevent incidents or to minimize the effects of an incident; e.g., hot-work procedures and permits. These approaches are commonly referred to as administrative controls.

"Risk control strategies in the first two categories, inherent and passive, are more reliable because they depend on the physical and chemical properties of the system rather than the successful operation of instruments, devices, procedures, and people." The inherent and passive categories should be implemented when feasible for new processes and facilities and used during the review of Inherently Safer Systems for existing processes if these processes could cause incidents that that could result in a Major Chemical Accident or Release. The final two categories do require the successful operation of instruments, devices, procedures, and people. The concepts that are discussed in the CCPS book, Inherently Safer Chemical Processes, A Life Cycle Approach, for looking at active and procedural applications of risk reduction, should be used in developing recommendations and mitigations from process hazard analyses along with the inherent and passive categories. This is good risk reduction. These concepts should also be used in the review and application of human factors in the process hazard analysis of new and existing processes.

Approaches to consider Inherently Safer Systems include the following[8]:

- Minimization – Use smaller quantities of hazardous substances (also called Intensification).
- Substitute – Replace a material with a less hazardous substance.
- Moderate – Use less hazardous conditions, a less hazardous form of a material, or facilities that minimize the impact of release of hazardous material or energy (also called Attenuation or Limitation of Effects).
- Simplify– Design facilities that eliminate unnecessary complexity and make operating errors less likely, and that are forgiving of errors that are made (also called Error Tolerance).

The County's guidance on the review of Inherently Safer Systems is broken down into seven separate sections. The first section addresses new covered processes; the second section addresses existing processes; the third section addresses mitigations resulting from Process Hazard Analysis (PHA); the fourth section defines feasibility; the fifth section addresses recommendations from process hazard analyses; the sixth section addresses Inherently Safer System Reports; and the seventh section contains

[8] CCPS, Inherently Safer Chemical Processes, A Life Cycle Approach, 1996

definitions. The ISS analyses must be performed for situations where a major chemical accident or release could reasonably occur.[9]

Safety Culture Assessment

Merriam-Webster defines "culture" as "the set of shared attitudes, values, goals and practices that characterizes an institution or organization." Safety culture is a measure of the importance that individuals and organizations exhibit towards working safely. It is the summation of attitudes and actions workers do at 2 a.m. on a Sunday night when no one is watching. An organization can influence employees to embrace positive shared safety values with consistent policies and practices and by leading through example.

History is filled with tragic life-altering and -ending events that can be traced back to phrases like, "we've been doing it this way for years" or "this way is good enough." This guidance document was prepared to help stationary sources identify pervasive attitudes or beliefs regarding risk tolerance in the work place. There is a correlation between improving safety culture and decreasing the number and severity of accidents.

Although stationary sources subject to Contra Costa County's or the City of Richmond's Industrial Safety Ordinances already frequently evaluate situations for "hidden" problems or latent conditions, safety culture is subtler and even more difficult to assess. A Safety Culture Assessment will enable a facility to understand where they are in terms of risk acceptance. Additional benefits of performing a Safety Culture Assessment include:

- Identify positive as well as negative aspects of the onsite health and safety program.
- Assist in identifying opportunities for improving health and safety.
- Another tool to improve facility personnel's awareness and participation in health and safety.
- Identify perception gaps between managers, supervisors, and the workforce.
- Assist to demonstrate management's commitment to safety by performing the assessment and visibly addressing the results.

Every company has a culture. Sometimes certain aspects of safety culture are more evident (e.g., using the proper personal protective equipment) and sometimes it is more of an undercurrent of how things are done (e.g., recommended hearing protection is absent when the 'boss' is not around). There will always be some element of risk in the workplace and in the work that is performed, but being cavalier about safety could lead to major problems beyond serious personal injury. Large facilities may have different cultures across departments, process units or even between shifts in the same process unit. Finding whether these differences exist is one of the challenges of the assessment.

[9] Process Hazard Analysis methods determine the risk of a deviation or potential incident. The risk determination is based on a combination of the hazard (severity) of the potential incident and likelihood (probability) of an incident occurring. If the potential hazard (severity) of consequence of a deviation meets the definition of a Major Chemical Accident or Release an ISS Analysis should be done for those that could reasonably occur.

In general, the larger and more broad the population being assessed, the less evident these differences in perception may appear. For example, 10 similar perceptions from one workgroup may not be noticeable in a facility-wide survey of hundreds; whereas these same 10 perceptions out of a total work group size of 30 would stand out. Depending on the size of the facility, the following work groups should be assessed: management, supervisors, operators, maintenance, engineering, health and safety personnel and resident and applicable transient contractors. To better understand potential differences in behavior and develop improvement strategies, facilities should consider identifying sub-work groups for the assessment between processing areas, shifts, crews, maintenance crafts or levels of management.

Performing an initial Safety Culture Assessment will give a company a baseline from which they can compare future assessments. Any Safety Culture Assessment represents only a snapshot in time. Since the safety culture of a company will change over time, only by performing multiple assessments can a company discover if the steps that were taken to improve safety are actually improving safety. If not, the company may need to adjust and focus future improvement topics.

The primary goal of a Safety Culture Assessment is to assess individual and group values towards safety and risk tolerance. An ultimate goal for each facility should be to assess values toward safety and risk tolerance associated with each work group. One objective of the Safety Culture Assessment is to gauge the commitment and effectiveness of an organization’s health and safety management program by evaluating attitudes, perceptions, competencies and patterns of behavior. Once these issues are known, a facility can direct the design, execution, evaluation and continuous improvement in the work environment to affect changes to safety-related behaviors and attitudes that ultimately minimize accidents.

More information on Contra Costa County's Safety Ordinance, including the Industrial Safety Ordinance Guidance Document can be found at the following web page: http://cchealth.org/hazmat/iso/.

Auditing Regulated Stationary Sources

Contra Costa Health Services has five engineers with one vacant position with industrial experience dedicated to the California Accidental Release Prevention Program and the Industrial Safety Ordinance. When an audit occurs at a petroleum refinery, it can take five engineers four weeks to complete the audit. The audit includes a review of the policies and procedures establishing the prevention elements that are required, review of the documents ensuring that the policies and procedures are being implemented as designed, interviewing operators and maintenance personnel to see if what is on paper is what is occurring in the plants, and to perform field evaluations. The purpose of the audits is to ensure that the programs in place meet the requirements of the California Accidental Release Prevention Program and the Industrial Safety Ordinance.

The audit includes 430 questions, the findings from the audit team, determination if the facility is in compliance with the requirement, actions to come into compliance, if out of compliance, proposed remedy, and a schedule to meet compliance. The proposed remedies and schedule are developed by the regulated stationary source and reviewed by the lead auditor. The regulated stationary source has ninety days to come up with a plan of action that is agreed upon by the auditing team. Follow-up on the actions being taken by the regulated source is reviewed during the next audit or during unannounced inspections. Table I shows an example of one of the questions with the proposed remedies from the regulated source.

Results

From May 1999 to August 2012 there was not a Major Chemical Accident or Release Severity Level 3 incident that occurred at a regulated stationary source[10]. Contra Costa Health Services staff has analyzed the Major Chemical Accidents or Releases (MCAR) that have occurred since the implementation of the Industrial Safety Ordinance. The analysis includes the number of MCARs and the severity of the MCARs. Three different levels of severity were assigned:

- Severity Level III – A fatality, serious injuries, or major onsite and/or offsite damage occurred[11]
- Severity Level II – An impact to the community occurred, or if the situation was slightly different the accident may have been considered major, or there is a recurring type of incident at that facility
- Severity Level I – A release where there was no or minor injuries, the release had no or slight impact to the community, or there was no or minor onsite damage

Figure 1 is a chart showing the number of MCARs from January 1999 through December 31, 2012 for the regulated Industrial Safety Ordinances facilities. The MCARs that have occurred at the County's Industrial Safety Ordinance stationary sources and a chart showing the MCARs that have occurred at the County and the City of Richmond's Industrial Safety Ordinance stationary sources. The chart also shows the number of Severity I, II, and III MCARs for this period.

A weighted score has been developed giving more weight to the higher severity incidents and a lower weight to the less severe incidents. The purpose is to develop a metric of the overall process safety of facilities in the County, the facilities that are covered by the County and the City of Richmond Industrial Safety Ordinances, and the facilities that are covered by the County's Industrial Safety Ordinance. A Severity Level III incident is given 9 points, Severity Level II 3 points, and Severity Level I 1 point. Figure 2 is a graph of this weighted scoring.

[10] On August 6, 2012 there was a major fire with major damage on site and a significant impact offsite.
[11] All the accidents that were listed during the 1990's were a Severity Level III MCAR

Table I

Number	Question ID#	Question	Findings	Answer	Actions	Proposed Remedy	Due Date	CCHS Comments
3	A12-08	Do the Process Hazard Analyses (PHA) address the identification of any previous incident, which had a likely potential for catastrophic consequences? [T19 CCR §2760.2©(2) & Section 450-8.016(d)(1)]	The PHA revalidation methodology includes a review of previous incidents. Tab 4 or 5 in the PHA binder is the listing of Chevron Incident investigation summary report reviewed by the PHA team. Per interview with personnel that participated in PHAs, incidents were reviewed and the likelihood of the event was adjusted to reflect incidents reviewed. The incidents discussed included Chevron events and incidents in other refineries/plants. These additional incidents discussed are not included in the PHA binder. CCHS reviewed T–C - (2/7/2008), there is an incident findings learning "solicit the team members to identify specialty or unique equipment whose failure could result in a loss of containment. This will be documented as either 'No specialty equipment discovered' 'or 'Specialty equipment discovered.' The PHA database has been updated to include this as a standard deviation.' Based on CCHS review of PHAs, the PHA data have not been modified to capture this learning/requirement.	P	Ensure the PHA database is modified accordingly when changes to the PHA process occur.	Chevron will include at least the list of incidents reviewed during PHA's and will include the review and analysis of specialty equipment (if any are identified) as a core deviation in each PHA.	12/15/08	None

Figure 1

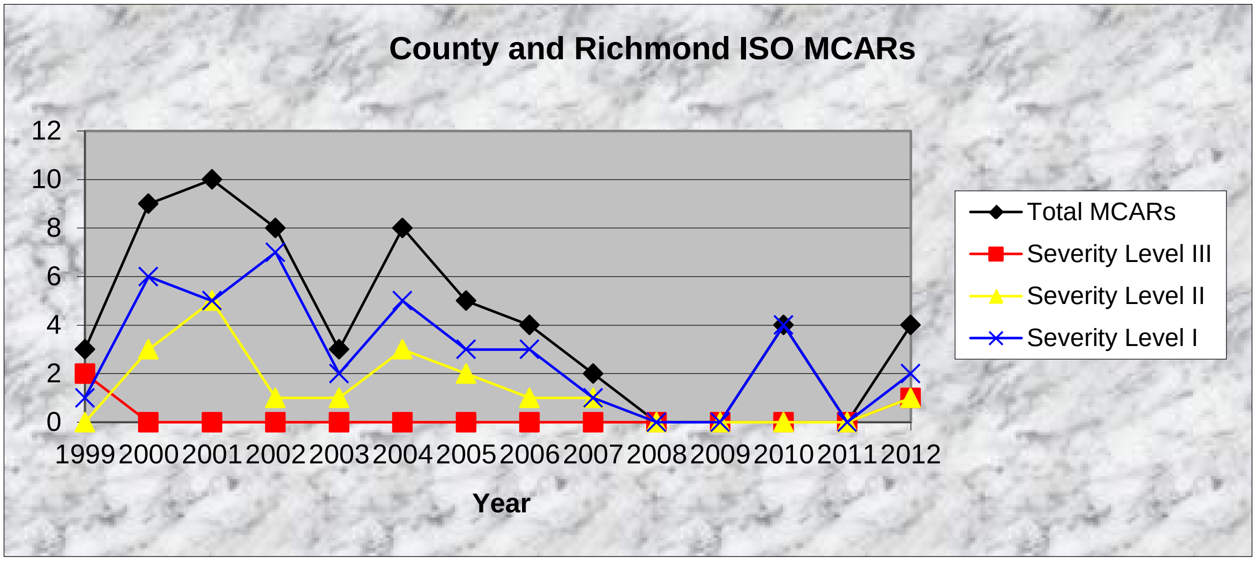
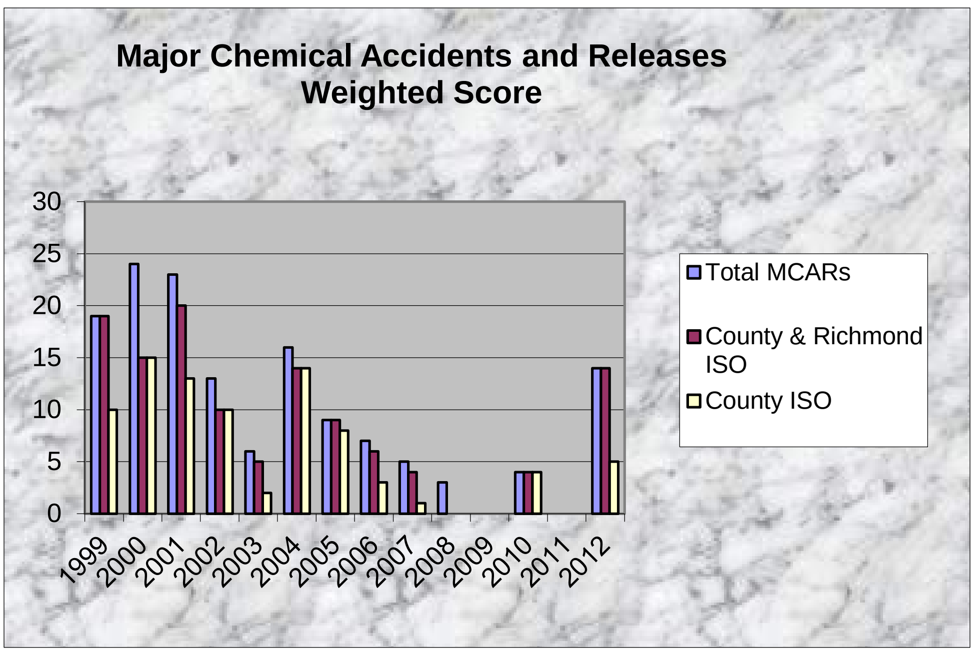


Figure 2



August 6, 2012 Chevron Fire

On August 6, 2012, a major fire occurred at the Chevron Richmond Refinery. The fire was caused by a failure of a pipe coming from a side cut of the atmospheric column in the crude unit. Six Chevron emergency responders received minor injuries as a result of the fire and over 15,000 people sought medical attention from August 6 through August 24, 2012. Five incident investigations (U. S. Chemical Safety and Hazard Investigation Board (CSB), U. S. EPA, Cal/OSHA, Bay Area Air Quality Management District, and Chevron) were started.

On January 30, 2012, Cal/OSHA issued 25 citations with 11being willful/serious, 12 serious, and 2 general. The total fine levied is $963,200. Chevron has appealed the citations through the Cal/OSHA appeal process. On April 19, 2013, the CSB issued an interim report with recommendations to Chevron, the City of Richmond, Contra Costa County, California, and the U. S. EPA. Use the following link to see a copy of the interim report: http://www.csb.gov/assets/1/19/Chevron_Interim_Report_Final_2013-04-17.pdf. Chevron issued their final root cause analysis of the incident on April 12, 2013. A copy of the Chevron root cause analysis can be found using the following link: http://cchealth.org/hazmat/pdf/2012_0806_chevron_30day_report_7th_Apr12.pdf. The U. S. EPA and the Bay Area Air Quality Management District incident investigations are ongoing.

The findings from the CSB interim report and the Cal/OSHA citations show that the pipe that failed had severe corrosion from high temperature sulfidation such that the wall of the pipe was less than a sixteenth of an inch thick. Inspections as far back as 2002 indicated that the pipe that failed had accelerated corrosion and should be monitored closely. Chevron was aware of high temperature sulfidation corrosion and that low silicon carbon steel pipe will have accelerated corrosion. Chevron's policy states that each component of piping that could see high temperature sulfidation corrosion should be inspected, at least, during maintenance turnarounds. Cal/OSHA and the CSB found that Chevron did not follow their own policy and that this component was not inspected. CSB and Cal/OSHA also questioned Chevron's decision not to shut down the crude unit when the leak occurred and that nineteen people were in the area of the pipe when the pipe failed and was engulfed in a vapor cloud.

The CSB is planning to issue a final report on the causes of the fire with their recommendations by the end of this year. The CSB is continuing to investigate issues including but not limited to: implementing a safety case regulatory regime in California; Chevron safety culture; indicator data collection and reporting; emergency response; off-site notification; stop work authority; and gaps in American Petroleum Institute recommended practices and standards.

Contra Costa Hazardous Materials Programs is hiring a third-party consultant to perform a safety evaluation of the refinery. The purpose of the safety inspection/audit is to review the safety culture, process safety management systems, and human factors associated with the operation of the refinery. Safety culture is a measure of the importance that individuals and organizations exhibit towards working safely. Process safety management system is a means to show management's commitment to process safety at the refinery. Human Factors is defined as: "A discipline concerned with designing machines, operations, and work environments so that they match human capabilities, limitations, and needs"[12]. Human Factors can be further referred to as: "…environmental, organizational, and job factors, and human and individual

[12] American Chemistry Council, formerly called the Chemical Manufacturers Association or CMA, (1990) A Manager's Guide to Reducing Human Errors

characteristics which influence behavior at work in a way which can affect health and safety."[13]

To assist in the safety inspection/audit, Contra Costa Health Services has established an oversight committee made up of four community members, representatives of the USW Local 5, Contra Costa Building Trades Council, a Contra Costa Health Services staff representative, two people with refinery technical experience, and two City of Richmond staff. The oversight committee has reviewed and approved: 1) the scope of work of the safety inspection/audit, and 2) the request for proposal for an outside consultant to work with Contra Costa Health Services in performing the safety inspection/audit. The oversight committee will select the outside consultant in early July and oversee the progress of the consultant during the evaluation and follow-up evaluation.

The safety inspection/audit will include public meetings; the onsite work of the consultant that will include interviews of Chevron personnel, review of documents, review of policies and procedures, inspection records, and other documents that assist in achieving the purpose of the safety evaluation; the preparation of a draft report; the preparation of a final report; and the presentation of the final report to the Richmond City Council and the Contra Costa County Board of Supervisors. A follow-up evaluation will occur six to twelve months after the initial evaluation to determine the progress that Chevron is making to address the findings and recommendations from the initial evaluation. The costs for the third-party safety evaluation will be paid for by Chevron.

Contra Costa County and the City of Richmond are in the process of revising the County's and the City of Richmond's Industrial Safety Ordinances to address the CSB recommendations. A committee that will include representatives from industry, United Steel Workers, Contra Costa Building Trades Council, community members, and the City of Richmond staff will work with Contra Costa Health Services staff to develop language for the revision to the Industrial Safety Ordinances. These revisions to the ordinances will then be presented to the Contra Costa County Board of Supervisors and the Richmond City Council for approval and adoption of the revisions.

The Bay Area Air Quality Management District is developing a Refinery Emission Tracking Rule that includes air monitoring around the refineries. The District is looking at what is in place and what additional air monitoring that would be beneficial during a chemical release or during a fire, including real-time particulate measurements.

Governor Brown has developed a working group on refinery safety. The Governor's working group has met with stakeholders that include community groups, regulators that have accident prevention oversight over the refineries, emergency responders, and industry representatives. The Governor's Task Force is planning to issue a report on proposed changes and actions that will address refinery safety in July 2013.

[13] Reducing Error and Influencing Behavior, HSG48, United Kingdom Health and Safety Executive (1999)

Fees

The maintenance, operations, training, and the continuous improvement of the Community Warning System are paid for by fees from regulated businesses that handle more than 500,000 pounds of hazardous materials.

The Industrial Safety Ordinance is paid for by fees based on the potential hazard that the facility poses. The potential hazard is assessed taking into consideration the following factors:

- The toxicity or flammability of the chemical.
- The quantity of the chemical stored in the largest vessel.
- The distance the largest vessel is from the fenceline of the regulated business.
- The volatility of the chemical.

An equation is used to determine the chemical potential hazard factor using the above four factors. Each chemical potential hazard factor is calculated. This factor is then multiplied by a factor based on the complexity of the regulated business and a factor based on the recent accidental history of the regulated business to give the regulated business potential hazard factor and then all of the chemical potential hazard factors are added together to get an overall factor for the chemicals handled by the regulated business. The percentage of the regulated business potential hazard factor to the sum of all the regulated businesses potential hazard factors is multiplied by the total overall expenses to implement the Industrial Safety Ordinance to determine the fee for that regulated business.

Conclusions

The Contra Costa County Board of Supervisors and the Richmond City Council adopted the Industrial Safety Ordinances and industry paid for and gifted the Community Warning System to Contra Costa County as a result of the major chemical accidents and releases that occurred in Contra Costa County during the 1990s and the outcry from the community. Today, there is a marked change in the way the petroleum refineries and chemicals operate. What was acceptable in the 1990s is not acceptable today. The industry is now held to higher standard than anywhere else in the Country through the County's and City's Industrial Safety Ordinances and the way that alert and notifications were required to be performed through the Community Warning System. The thorough auditing and the follow-up by the Accidental Release Prevention Program Engineers sets a high standard that is most cases is being met by the regulated sources. The result is the number and severity of accidents that have occurred within the County have declined dramatically.

Parish of Ascension

OFFICE OF HOMELAND SECURITY &
EMERGENCY PREPAREDNESS

TOMMY MARTINEZ
Parish President

Richard A. Webre
Director

Jun 20, 2013

TO: The Honorable Barbara Boxer, Chairman
Senate Committee on Environment and Public Works

The Honorable David Vitter, Ranking Member
Senate Committee on Environment and Public Works

FROM: Richard Webre, Director, Ascension Parish Office of Homeland Security
828 South Irma BLVD, BLDG 3, Gonzales, LA 70737

SUBJECT: Hearing on Federal Risk Management Involving Chemical Threats.

Dear Madam Chairman,

I understand that the purpose of this hearing is to conduct over site of federal programs designed to prevent, mitigate, and address chemical threats, including risk management, emergency planning, and community right to know programs. I'm not a chemical or mechanical engineer; therefore, will not comment on technical prevention of industrial incidents, but I will provide insight from a local emergency management perspective. Emergency managers at the local level of government are tasked with the functions mentioned above as well as with coordination efforts for all hazards within their jurisdiction. Petro-chemical threats are only one of these hazards and are coordinated and planned within our jurisdiction through a Local Emergency Planning Committee (LEPC) that is mandated by the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. A well managed LEPC is the most critical function that a community can perform to prevent, mitigate, respond to and recover from an industrial incident.

I cannot emphasize enough that all disasters are initially local. Federal legislation governing local planning efforts for chemical threats at fixed facilities are unfunded mandates that are written at the strategic level of management. It is then interpreted operationally at the state level of government through a State Emergency Response Commission (SERC). Unfortunately, in many cases the tactical core that plans for and coordinates response to these incidents at the local level of government is at times either overlooked or not enforced. I believe that these federal laws are not enforced for several reasons:

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1. Formal training and education for emergency managers in overseeing an LEPC is nearly nonexistent. An LEPC hand book and the legislation itself is all that I ever had access to.
2. Chairing the LEPC should be the responsibility of the duly appointed local emergency manager at the county level of government and should never be assigned to another entity or chemical industry personnel.
3. There are no consequences should local or state governments choose not to enforce or poorly enforce the federal EPCRA mandate for an LEPC.
4. The federal mandate to plan and coordinate with industry at the local level of government is unfunded.
5. Funding that is available to local governments through federal grants (i.e. HMEP, EMPG) are in many cases retained at the state level of government.
6. TIER II filing fees that could assist in managing an emergency management office and coordinating with industry are at times retained at the state level of government.
7. Metrics do not exist in determining the performance level of an LEPC or SERC.

I'll be brief, but please allow me to elaborate on the history of the federal laws that we are discussing, which may illustrate why I believe that these mandates are not adequately enforced. In 1984 the Bhopal Disaster occurred, which was the world's worst industrial catastrophe. At a Union Carbide plant in Bhopal India forty metric tons of methyl isocyanine was accidentally released resulting in an immediate death toll of 2,259 Bhopal residents with an additional 3,900 receiving permanently disabling injuries.

In reaction the U.S. Congress passed an important piece of legislation, the Emergency Planning and Community Right to Know Act along with other legislation in 1986. This unfunded federal mandate with dual legislative purposes was the principle guiding doctrine of emergency managers for the next fifteen years in terms of petro-chemical emergency planning and public outreach. The office that I currently manage exits today because of this legislation.

In terms of emergency management September 11, 2001 changed our environment forever. To name only a few changes multiple Homeland Security Presidential Directives were issued, the Chemical Facility Anti-Terrorism Standards (CFATS) were developed and maritime security (MARSEC) standards for petro-chemical docks were enforced; however, none of this superseded legislation from the U.S. Department of Transportation governing railway and pipeline incidents, nor any element of the EPCRA law.

Then on August 23, 2005 hurricane Katrina occurred and the emergency management pendulum began to swing away from antiterrorism and back towards preparedness for natural disasters. Flooding events in the Midwest, tornados in Alabama and Oklahoma, and Super Storm Sandy reinforced this. Currently, with the incidents in West, Texas and Geismar, Louisiana we have come full circle.

I am the past president of the Louisiana Emergency Preparedness Association, and one of my responsibilities was oversight of the Louisiana Emergency Manager Certification and training program. I have traveled the state stressing the importance of maintaining a strong LEPC while

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trying to accomplish the tasks associated with recent state and federal emergency management doctrine.

I believe that because of new federal doctrine developed over the past thirteen years much less emphasis has been placed on EPCRA and the LEPC at the local level of government; however, I don't believe that more legislation is the answer. Again, let me reemphasize that all disasters are initially local, and I believe that state and federal legislation regarding chemical facility, pipeline, and railway incidents need to be compared, assessed and de-conflicted.

Each time that I assess the mandates from the state and federal government regarding chemical facilities, pipelines, railways, or natural disasters I refer to a quote over the door of the U.S. Army G-2 Section at the Pentagon: "Remember, at the end of every grandiose plan is an eighteen year old infantryman walking point." There may be a 21 year old young lady who is a 911 dispatcher that initiates all response to a major chemical related incident, or an 18 year old firefighter who is the first to arrive on scene. Instructions to them must be predetermined and simplistic. Complexity results in failure on scene.

My staff has developed complex emergency operations plans, hazardous material commodity flow studies, and risk-consequence assessments, all of which are excellent documents for performing long range planning, training and resourcing; however, they are useless during an incident. Creating one common operating picture between the chemical industry, the local 911 center, the Emergency Operations Center and the first responders on scene is absolutely critical. Simple, inexpensive, graphically displayed, two page standard operating procedures can accomplish this. EPCRA states that site specific plans should be developed for each facility in a jurisdiction. There is not a recommended format for this but these simple two page site specific plans can contain:

- Facility emergency points of contact.
- Half mile, one mile, and two mile radiuses around the core chemical processing units.
- One square mile emergency location grids.
- Adjacent facilities and critical infrastructure such as schools, businesses and residential areas that need to be protected, warned, evacuated, or sheltered in place.
- Predetermined road blocks to ensure that the public remains out of the hazard area.
- A brief list of extremely hazardous substances produced by the facility that allows fire chiefs to determine if an offensive attack is needed, or to move personnel to a safe location and allow the product to burn.
- Facility access gate locations.
- Siren identification numbers.
- Triage and command post locations.

No one appreciates technology more than I do; however, there is no app for this nor should there be. If industry is forced to comply with the installation of a mandated online reporting system the problem of triggering the system still exists. As an example, if an operator at a chemical facility experiences a catastrophic explosion and fire the last thing on his or her mind is logging onto a website, sitting behind a key board, and typing situational awareness information to government agencies echelons above their level; however, they can easily key up a radio and

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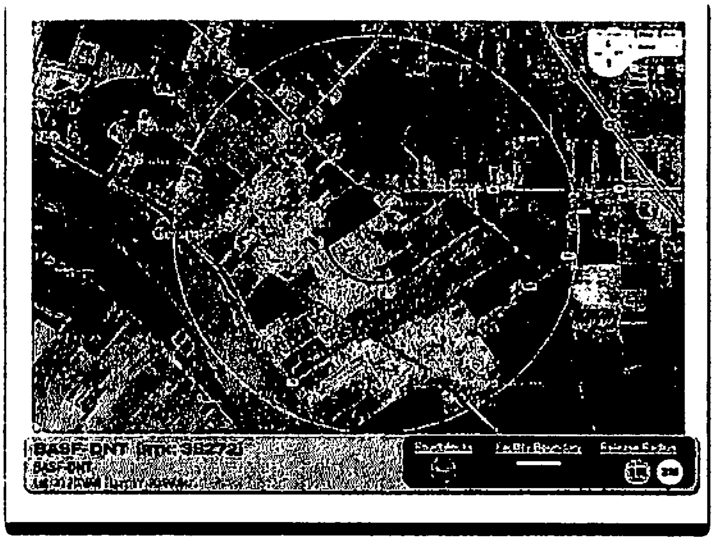
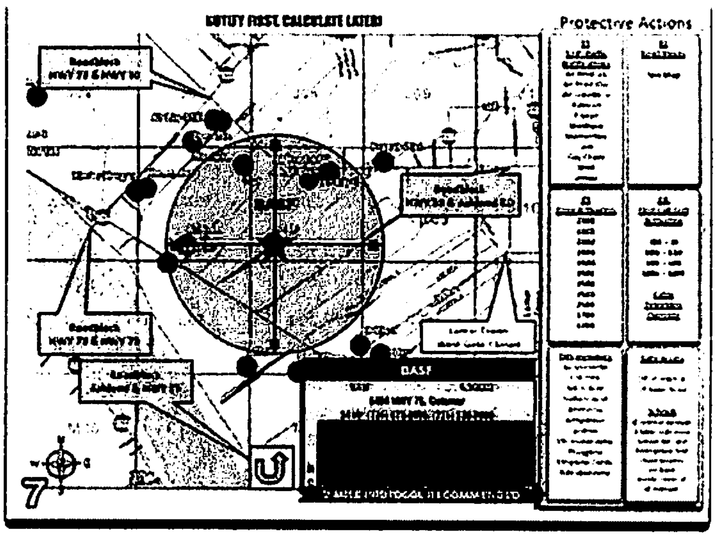
begin speaking to a 911 dispatcher reporting life-safety issues and requesting assistance. Additionally, government agencies that are echelons above their level do not have their fingers on the button that activate critical protective actions on scene. The 911 center usually does. The simple plans illustrated below are screen captures from plans in our jurisdiction similar to the one used during the recent incident in Geismar, LA.





I cannot express how important the radio communications layer is during a petro-chemical incident. There are 33 Tier II chemical facilities in our jurisdiction and all of them possess a P-25 compliant interoperable radio capable of communicating directly with the 911 center, the Emergency Operations Center, and the first responders on scene. They communicate while referring to the maps listed above. This is what I referred to as one common operating picture.

None of this could have been accomplished without having an extremely robust LEPC in place. There are no decisions that involve response to a chemical facility within our jurisdiction that are made in a vacuum. Local industry has been instrumental in coordinating with the LEPC as well as funding and managing the Ascension Parish Community Awareness Emergency Response (CAER) committee and the Geismar Area Mutual Aid Association (GAMA). The Ascension Parish CAER Committee funds and maintains the community siren system, defrays the cost of our reverse 911 system, and manages public outreach to the near site population. GAMA provides mutual aid across a three county jurisdiction for emergency response equipment and coordinates the installation of emergency radios for each facility.

I have been in my position for seven years. Before June 2013 we experienced only two general emergencies in the chemical industry resulting in zero fatalities or injuries. Two weeks ago we experienced two general emergencies in two days resulting in three fatalities and over one hundred injuries to chemical workers. No other injuries were sustained by first responders or the general public, and no damage was reported to adjacent critical infrastructure. I attribute this in large part to the ability of the first responder community and the chemical industry being able to operate effectively within a unified command. This could not have happened without prior planning, training and coordination. I believe that additional legislation and mandated IT platforms are not the answer. My recommendations are listed below:

1. De-conflict all federal legislation associated with chemical facilities as it applies to local government.
2. Modify EPCRA allowing strict enforcement of LEPC management.
3. Assign LEPC management to the duly appointed emergency manager at the county level of government.
4. LEPC meetings should be held at least quarterly.
5. Empower the LEPC with the ability to enforce EPCRA standards on chemical facilities that do not comply, not by contacting the EPA or a federal attorney, but within their own jurisdiction.
6. Provide funding directly to the emergency management office for LEPC management, but not without metrics to measure performance. Make this funding competitive if necessary for jurisdictions with a large petro-chemical presence.
7. Ensure that TIER II filing fees are shared with the LEPC or emergency management offices.
8. Ensure that emergency management grants and hazardous material grants are passed through to local government and that the assigned metrics are enforced.
9. Design and implement mandatory training for LEPC management.
10. Develop a simple standard for site specific response plans.
11. If anything is mandated to the petro-chemical industry, mandate that they possess a radio capable of communicating with the local 911 center, the EOC and first responders.

Sincerely,

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Testimony of Paul Orum

Consultant
Coalition to Prevent Chemical Disasters

Before the

Senate Environment and Public Works Committee

Oversight of Federal Risk Management and Emergency Planning Programs to Prevent and Address Chemical Threats, Including the Events Leading Up to the Explosions in West, TX and Geismar, LA

June 27, 2013

My name is Paul Orum. I thank the committee for the opportunity to present views important to a broad coalition of environmental health, labor, and community organizations known as the Coalition to Prevent Chemical Disasters. My background for 25 years is government information policy regarding hazardous materials.

Recent deadly explosions in West, Texas and Geismar, La., among others, remind us of the need for more effective public protections from industrial chemicals in populated areas.

- These recent incidents are hardly rare. The National Response Center recorded more than 11,000 oil and chemical spills in the last year alone.[1]

- The potential for large-scale incidents is ever present. A Congressional Research Service analysis indicates more than 470 facilities have vulnerability zones potentially affecting any of 100,000 or more people in the event of a worst-case toxic gas release.[2]

- Similar scenarios repeat. The fire and explosion at West Fertilizer is reminiscent of an event in Kansas City, Missouri, at which a construction facility storing ammonium nitrate first caught fire and then exploded killing six firefighters after they had responded to the fire. That was November 29, 1988.

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[1] On-line search of National Response Center conducted June 20, 2013. NRC is the national point of contact for reporting oil and chemical spills.
[2] Congressional Research Service memorandum to Senator Frank R. Lautenberg, *RMP Facilities in the United States,* November 16, 2012.

In general, the chemical safety landscape includes a lot of neglect, missed communication, static regulations, voluntary standards, and prosecution afterwards. There is not enough on prevention, technically competent inspections, community-wide awareness, producer responsibility, and safer alternatives. Regulations should not only control problems but also generate safer solutions. Accident prevention is ultimately more effective than response.

Risk management and emergency planning should be revised and updated in light of ongoing and recent plant explosions.

1] Risk management planning should include reactive chemicals like the ammonium nitrate that detonated at West Fertilizer. Where there is serious potential harm to the public, reactive chemical hazards should be included in Risk Management Plans (RMP) under the Clean Air Act, section 112(r). The Chemical Safety and Hazard Investigation Board has an open recommendation to EPA to this end:

> *Revise the Accidental Release Prevention Requirements, 40 CFR 68, to explicitly cover catastrophic reactive hazards that have the potential to seriously impact the public, including those resulting from self-reactive chemicals and combinations of chemicals and process-specific conditions. (Recommendation No. 2001-1-I-H-R3)*

While the general duty clause of the clean air act presumably covers all facilities that hold extremely hazardous substances – including reactive substances that pose catastrophic hazards – the general duty does not explicitly cover important *proactive* elements of RMPs, such as the requirement to assess and communicate chemical hazards. Adding ammonium nitrate to the RMP program could have informed the owner of West Fertilizer, first responders, and the public about the magnitude of the danger, including off-site consequences, and might have prevented or reduced the tragic consequences of the explosion.

2] Management systems and controls do fail. Chemical facility owners and operators have a responsibility not only to understand their own chemical hazards, but also to understand less hazardous alternatives that are commercially available in their industry. EPA should require chemical facilities to review and include in RMPs available methods that prevent potential consequences of a worst-case incident. Such methods are often the most effective measures to protect workers at the site, emergency responders, and nearby populations.

Surveys show that the RMP process has prompted some companies to reduce or remove chemical hazards, one of the objectives of the program. The RMP process facilitates changes that companies may be considering for a variety of reasons, including safety, security, and other regulatory requirements.

- More than 554 drinking water and wastewater facilities converted from toxic inhalation hazard chemicals, removing dangers to more than 40 million Americans. (The 554 facilities are examples among other facilities that have converted to less hazardous operations.)[3]

- Facilities across some 20 industries already use options that do not pose the danger of a major toxic gas release, including bleach producers, water utilities, power plants, refineries, aluminum smelters, and many types of manufacturers.[4]

- Facilities that convert to safer operations may save money when all factors are considered, such as avoided costs of release control devices, liability insurance, regulatory compliance, personal protective equipment, site security, and emergency planning.[5]

These facilities typically substituted a less hazardous replacement chemical or process; used a chemical in a less hazardous form (such as less concentrated, or aqueous instead of gaseous); or adjusted the process design to minimize use or storage (such as generating the chemical on site as-needed without storage). These strategies are distinct from conventional risk management approaches such as containment, control, mitigation, or recovery of substances.

The House and Senate reports on the Clean Air Act Amendments of 1990 show that Congress viewed measures to remove avoidable chemical hazards as integral to the statutory goal of preventing accidental releases:

> *Measures which entirely eliminate the presence of potential hazards (through substitution of less harmful substances or by minimizing the quantity of an extremely hazardous substances present at any one time), as opposed to those which merely provide additional containment, are the most preferred.*[6]
>
> *Hazard assessments…include a review of the efficacy of various release prevention and control measures, including process changes or substitution of materials.* [7]

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[3] Center for American Progress, *Leading Water Utilities Secure Their Chemicals*, March 2010.
[4] Center for American Progress, *Chemical Security 101: What You Don't Have Can't Leak, or Be Blown Up by Terrorists*, November 2008.
[5] Center for American Progress, *Preventing Toxic Terrorism: How Some Chemical Facilities Are Removing Danger to American Communities*, April 2006.
[6] Senate Report on the Clean Air Act Amendments of 1990 Report # 101-228 (S-1630), page 209.
[7] House of Representatives, Clean Air Act of 1990: Conference Report to Accompany S-1630. Report #101-952 (October 26, 1990), page 349.

EPA took public comment on inherently safer approaches for facility design and operations when first implementing the RMP program.[8] Unfortunately the agency did not develop the approach at the time. As a result, covered facilities are not required to evaluate feasible chemical hazard reduction alternatives that may be the most effective safety measures. Basic prevention analysis elements such as the avoided costs and liabilities associated with alternate technologies are not standard elements of RMPs. Such elements are foundational to developing knowledge of solutions. They are among the elements that help make organizations intelligent about the advantages, costs, and feasibility of technology options.

In March 2012, EPA's National Environmental Justice Advisory Council urged the agency to prevent chemical disasters by more fully using its authorities to advance safer chemical processes under the Clean Air Act.[9] In July 2012, more than 50 organizations petitioned EPA to commence rulemaking under the Clean Air Act and to revise agency guidance for enforcement of the general duty clause.[10]

The EPA Administrator has authority under the Clean Air Act, section 112(r), to incorporate methods that prevent potential consequences into RMPs and should do so.

3] The explosion at West Fertilizer illustrates the importance of the Clean Air Act's general duty to operate safely. West Fertilizer was subject to an incomplete patchwork of chemical safety regulations regarding ammonium nitrate. The general duty clause holds firms responsible for understanding and managing their chemical hazards regardless of the completeness of government actions to regulate those hazards. For example, the ammonium nitrate at West Fertilizer was not on the RMP list of substances and thresholds. The general duty is an important tool for not only enforcement but also prevention. EPA's implementation guidance for the general duty clause recognizes that removing chemical hazards can be an effective safety measure, but EPA should further develop the concept in this guidance. We strongly oppose restricting the general duty clause in ways that could hamper enforcement or prevention. We also oppose arbitrarily fragmenting federal authorities between safety and security. By Presidential directive, the U.S. EPA is the lead agency to oversee security at drinking water and wastewater facilities.[11]

4] EPCRA emergency planning notification is incomplete. The ammonium nitrate that exploded at West Fertilizer was not on the EPCRA section 302 list of substances that require emergency planning notification. EPCRA section 302 requires facilities that hold threshold amounts of listed chemicals to notify their State Emergency Response Commission (SERC)

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[8] 60 Federal Register 13526, March 13, 1995.
[9] National Environmental Justice Advisory Council letter to EPA Administrator Lisa P. Jackson, March 14, 2012.
[10] Petition to the Environmental Protection Agency to Exercise Authority Under Section 112(r) of the Clean Air Act to Prevent Chemical Facility Disasters Through the Use of Safer Chemical Processes, July 25, 2012.
[11] Homeland Security Presidential Directive/HSPD 7, *Critical Infrastructure Identification, Prioritization, and Protection,* December 17, 2003.

and designate a point of contact at the facility to participate in emergency planning. It should be acknowledged that local emergency response capacities are often starkly overmatched by the magnitude of chemical hazards, and that activity levels of Local Emergency Planning Committees (LEPC) vary widely. Too much is left to the mostly-volunteer LEPCs – states should have fee-based programs that support hazard reduction, inspections, and regular drills. Nonetheless, EPCRA 302 notifications are a starting point for local emergency planning. The EPA Administrator has responsibility to modify the EPCRA 302 list and should do so. While lists and thresholds will inevitably fall short – hence the need for a general duty to operate safely – EPA should revise the EPCRA 302 list to include common substances that are known emergency hazards. This process should include both proactive listing criteria and a review of substances involved in serious incidents reported to the National Response Center.

5] EPCRA inventory reporting is valuable but insufficient. Owners and operators of facilities that hold large amounts of hazardous chemicals have an obligation to clearly communicate chemical hazards to those who could be affected prior to an emergency. West Fertilizer did report ammonium nitrate to the Texas SERC under EPCRA section 312 (a Tier II report). Texas apparently maintains Tier II reports in an electronic format, which is important. EPA should continue to support and promote free electronic information management tools such as Tier II Submit, RMP*Comp, and CAMEO. The EPA should also develop routine electronic access to EPCRA 312 Tier II data from each state through memoranda of understanding or other means (as should OSHA and DHS). EPA should also promote awareness of reporting and planning obligations among regulated facilities. However, simple awareness of chemicals on-site is not sufficient. Local emergency planners and responders need not only chemical inventories but also worst-case and planning-case scenarios (which are included in RMPs but not EPCRA Tier II reports). They also need regular information about the number and type of high-hazard shipments in all modes of transportation. Fee-based programs should support prevention, pre-fire planning, technically competent inspections, drills, and NFPA-compliant hazmat training – including clear reminders that evacuating may be the most prudent course of action.

6] Independent investigations are important. The Chemical Safety and Hazard Investigation Board, also established by the Clean Air Act 112(r), produces root cause investigations and safety recommendations after the most serious chemical accidents. These activities are important to the public because they provide credible information and focused recommendations for change. Barriers to effective investigations, such as site access and preservation, should be resolved.

Issues beyond EPCRA and Clean Air Act, 112(r):

7] Schools and nursing homes shouldn't be in potential blast zones. It is not an easy problem. Communities may grow up around chemical facilities or vice versa, but they are too close together in many places. State and local planners could benefit from federal guidelines for substantial safe setback distances, based on a worst-case scenario, in order not to continue to compound the problem when siting new buildings. School buildings were badly damaged by the blast in West, Texas. School siting criteria should take into account proximity to hazardous chemical facilities. Recipients of federal construction funds for buildings that will be used by potentially vulnerable populations (such as head start schools, hospitals, or nursing homes) should be subject to oversight to prevent building in the near zone of potential harm. In addition, the agricultural chemicals security tax credit assists agricultural distributors with conventional security measures such as fences and lights; it should assist facilities that want to move locally to safer locations.

8] Hazardous chemical operations shouldn't be underinsured. West Fertilizer reportedly carried only $1 million in liability insurance, a fraction of the estimated $100 million in property damage alone. Companies that hold large amounts of extremely hazardous substances should be required to maintain sufficient liability insurance to cover a worst-case chemical release. Such a requirement would provide a reasonable cost incentive for companies to develop and use feasible alternatives. In addition, common carrier obligations encourage widespread overuse of railcars for shipping and storing extremely hazardous substances. Railroads have sought to have shippers share liability risks associated with extremely hazardous substances (which they are required to carry) and to have shippers develop safer substitutes.[12]

Sustained improvement in chemical hazard prevention, preparedness, and response is long term and involves a range of actions. Among the most immediate lessons from the West Fertilizer explosion are for EPA to make sure major recognized hazards are 1) included in the programs designed to address them, 2) subject to safer alternatives analysis by the companies that hold them, 3) covered by appropriate lists and thresholds, and by the general duty to operate safely.

Thank you again for the opportunity to testify. I would be glad to take any questions.

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[12] Center for American Progress, *Toxic Trains and the Terrorist Threat: How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities,* April 2007.

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Submitted to the

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

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On

Oversight of Federal Risk Management and Emergency Planning Programs to Prevent and Address Chemical Threats, Including the Events Leading Up to the Explosions in West, TX and Geismar, LA

Thursday, June 27, 2013

Introduction

My name is M. Sam Mannan and I hold a BS, MS, and PhD in chemical engineering. I am a registered professional engineer in the states of Louisiana and Texas, and I am a certified safety professional. I am a Fellow of the American Institute of Chemical Engineers and a member of the American Society of Safety Engineers, the International Institute of Ammonia Refrigeration, and the National Fire Protection Association. I am Director of the Mary Kay O'Connor Process Safety Center, holder of the T. Michael O'Connor Chair I in Chemical Engineering, and Regents Professor of Chemical Engineering at Texas A&M University. The Center was established to memorialize Mary Kay O'Connor, a chemical engineer who, along with 22 others, died in a chemical plant explosion in 1989 in Houston, Texas. The Center mission is to lead the integration of process safety – through education, research, and service – into the education and practice of all individuals and organizations involved in chemical operations. The vision of the Center is to serve as the premier process safety resource for all stakeholders so that safety becomes second nature for managers, engineers, and workers as progress continues toward zero injuries and lost lives. The Center seeks to develop safer processes, equipment, procedures, and management strategies that will minimize losses in the process industry. My area of expertise within the chemical engineering discipline is process safety. I teach process safety engineering both at the undergraduate and graduate level. I also teach continuing education courses on process safety and other specialty process safety courses in the United States and overseas. My research and practice is primarily in the area of process safety and related subjects. The opinions presented in this document represent my personal position on these issues. These opinions are based on my education, experience, research and training.

Risk management and emergency planning programs to prevent and address chemical threats are of extreme importance for the protection of the workforce, public, and the environment. These programs are also of great importance for the US national economy and security. I applaud the US Congress for continuing to pay attention to such important issues, and I appreciate the opportunity to provide my opinions in this process.

Background

Chemicals play a key role in today's high-tech world. The chemical industry is linked to every technologically advanced industry. Only a handful of the goods and services we enjoy on a daily basis would exist without essential chemical products. Chemicals are also a big part of the economy in Texas and many other states. For example, the Texas chemical industry alone provides more than 100,000 jobs, and the state's chemical products are shipped worldwide at a value of more than $20 billion dollars annually.

But the use of chemicals is a two-edged sword. Safe use creates a healthier economy and a higher standard of living. Unsafe use threatens our lives, our businesses and our environment. As the industry's sophistication increases, so does the need to work and live safely with chemicals. In order to accomplish this, many stakeholders must work together diligently and with persistent determination. A common theme that also must be present is competence at all levels with regard to knowledge and execution of responsibilities.

Today's hearings are an appropriate congressional response to the recent events in West, Texas, and Geismar, Louisiana. Both these events were tragic and our heart goes out to the affected people, neighborhoods and cities, and the local authorities. We must as a nation and individuals explore and investigate these incidents and do our best to prevent the recurrence of such incidents. The hearings are focused on federal oversight programs, and I will limit majority of my testimony to that topic. However, because of the nature of accident prevention and role of all stakeholders, I will at times touch on those issues as well. Also, at the Center we had one PhD researcher working on ammonium nitrate before the West, Texas incident happened, and since the West, Texas incident, we have had a team of five PhD researchers working under my guidance on researching this whole issue and associated topics. Therefore, much of my testimony and opinions are derived from looking at the aftermath of the West incident. Wherever possible, I have tried to include information and knowledge derived from the Geismar, Louisiana, incident and its aftermath. I must also state that much is still unknown about these incidents and as the root causes are identified and more definitive information becomes available, some of these conclusions and opinions may have to be revisited.

The West, Texas, Incident

On Wednesday, April 18, 2013, an initial fire exacerbated into an explosion at West Fertilizer in West, Texas, causing the death of 15 people and injuring more than 200. The blast wave completely destroyed the facility and also caused varying levels of damage to many buildings, businesses, and homes at significantly long distances from the plant. More than 50 homes, a 50-unit apartment building, a nursing home and four schools were in the impact zone. Of the 15 people who died, 12 were emergency responders, who were responding to the initial fire and trying to control and extinguish the fire when the catastrophic explosion occurred.

The Geismar, Louisiana, Incident

On Thursday, June 13, 2013, an explosion occurred at Williams Olefins in Geismar, Louisiana, causing the death of two people and injuring more than 70.[1] Residents from a nearby community (St. Gabriel) were instructed to shelter in place.[2] This facility handles toxic chemicals and there was a concern about the air quality; therefore, the Louisiana Department of Environmental Quality (DEQ) checked the air quality during the subsequent days.[3] On the same day of the incident, the National Oceanic and Atmospheric Administration's (NOAA) Scientific Support Coordinator (SSC) was contacted by the US Coast Guard (USCG) regarding the plant fire and explosion at the Williams facility. Currently the USCG is requesting weather and plume modeling from NOAA.[4] An official report of total damages caused by the explosion is not available yet.

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[1] http://co.williams.com/williams/news-media/geismar-update/

[2] http://www.nola.com/traffic/baton-rouge/index.ssf/2013/06/explosion_at_williams_olefins.html

[3] http://www.deq.louisiana.gov/portal/WilliamsOlefins.aspx

[4] Emergency Response Division, Office of Response and Restoration,
National Ocean Service, National Oceanic and Atmospheric Administration, US Department of Commerce.
http://incidentnews.noaa.gov/incident/8613

Federal Oversight Programs for Risk Management and Emergency Planning and Lessons Learned from West, Texas, Incident

The West Fertilizer facility had a capacity to store 110,000 lbs of ammonia and 540,000 lbs of ammonium nitrate (Tier II reporting data from 2012). The discussion below provides a summary of different federal regulations the West facility was required to comply with and the known status of such compliance and the oversight role played by the respective federal agencies.

OSHA Regulations

The Occupational Safety and Health Administration (OSHA) has general and specific regulations that would apply to the use and possession of Ammonium Nitrate (AN). Appendix A provides a more detailed discussion on potential coverage/oversight of the West Fertilizer facility by OSHA regulations and the regulatory requirements.

The West facility was required to comply with specific OSHA regulations, including the *Hazard Communication Standard* (29 CFR 1910.1200) and *Explosives and Blasting Agents Standard* (29 CFR 1910.109). While it is not clear what the compliance status of the facility was at the time of the incident, it can be argued that compliance with these programs could have prevented or mitigated the incident.

Compliance with the *Explosives and Blasting Agents Standard* also has many measures that would have prevented or mitigated the incident. For example, the ammonium nitrate was stored in a warehouse, in very close proximity to the seed area. "Ammonium nitrate shall be in a separate building or shall be separated by approved type firewalls of not less than 1 hour fire-resistance rating from storage of organic..."[5] Seed is an organic and combustible material, which could propagate the fire to areas where ammonium nitrate was stored. Storage of ammonium nitrate at an adequate distance from the seed area might have helped in preventing the explosion. It is unknown – but unlikely – whether the warehouse had firewalls. Firewalls would have prevented ammonium nitrate from heating and reaching the onset temperature of decomposition. The warehouse construction material was wood, which is also a combustible material. Overall, from what is known, the storage of ammonium nitrate at West Fertilizer Company did not provide adequate measures to prevent overheating and propagation of fire, which eventually lead to the explosion. "Not more than 2,500 tons (2270 tonnes) of bagged ammonium nitrate shall be stored in a building or structure not equipped with an automatic sprinkler system."[6]

Proper training on the hazards of ammonium nitrate and knowledge about a potential violent decomposition might have allowed firefighters to take a different approach when responding to and fighting the initial fire.

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[5] 29 CFR 1910.109(i))
[6] Id.

General requirements include the "*General Duty Clause*" of the Occupational Safety and Health Act (P.L. 91-596, as amended) and an Emergency Action Plan (EAP) according to OSHA Standard 1910.38[7]. The "*General Duty Clause*" requires employers to provide employees with a workplace that is free from *"recognized hazards that are causing or are likely to cause death or serious physical harm"*[8].

The Risk Management Plan submitted by West Fertilizer Company to the US Environmental Protection Agency states that the company had an EAP[9]. However, the EAP is not publicly available.

The West facility was not covered by the Process Safety Management (PSM) standard (29 CFR 1910.119) even though it stored large quantities of anhydrous ammonia (a listed chemical under the PSM standard). OSHA proposed to exclude retail facilities, oil and gas well drilling and servicing operations and normally unmanned remote facilities from the [PSM] standard.[10] A brief summary of the PSM standard is provided in Appendix A. It should be noted that hazard analyses done under the PSM standard would have likely suggested prevention and mitigation measures similar to those provided under OSHA 1910.109 and NFPA 400.

The most recent known OSHA inspection of the West site was conducted in 1985. A fine of $30 was levied attributed to inadequate anhydrous ammonia storage and failures in Personal Protective Equipment (PPE).

EPA Regulations

Similar to OSHA, EPA also has a general duty clause and specific regulations that apply to the West Fertilizer facility. Appendix B provides a more detailed discussion on potential coverage/oversight of West Fertilizer by EPA regulations and the regulatory requirements.

Under the Clean Air Act Section 112(r)(1), the *General Duty Clause* states: *"The owners and operators of stationary sources producing, processing, handling or storing such substances [i.e., a chemical in 40 CFR 68 or any other extremely hazardous substance] have a general duty [in the same manner and to the same extent as the general duty clause in the Occupational Safety and Health Act (OSHA)] to identify hazards which may result from (such) releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur."*

The *General Duty Clause* applies to any stationary source producing, processing, handling, or storing regulated substances or other extremely hazardous substances. "Other extremely

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[7] Shea, D.A., Schierow, L.J., Szymendera, S. (2013) Congressional Research Service. *Regulation of Fertilizers: Ammonium Nitrate and Anhydrous Ammonia.*

[8] 29 U.S.C. §654(a). http://www.gpo.gov/fdsys/pkg/USCODE-2010-title29/pdf/USCODE-2010-title29-chap15-sec654.pdf

[9] West Fertilizer Company Risk Management Plan, http://www.rtknet.org/db/rmp/rmp.php?facility_id=100000135597&datype=T&reptype=f&detail=4&submit=GO

[10] *Fed. Reg. 6355, 6363 (Feb. 24, 1992)*

hazardous substances" are any chemicals listed in 40 CFR 68, or any other chemicals, which may be considered extremely hazardous. Thus, it would seem the EPA has wide-ranging authority under the *General Duty Clause* to regulate West Fertilizer or other such facilities.

In addition to the EPA *General Duty Clause*, the following specific EPA regulations also apply to West Fertilizer:

- EPA's Risk Management Program (RMP) Rule (40 CFR 68) is intended to prevent and mitigate accidental releases of listed toxic and flammable substances. Requirements under the RMP rule include development of a hazard assessment, a prevention program, and an emergency response program. West Fertilizer would be regulated under the Program 2 requirements of the RMP rule because of the storage quantities of ammonia. Ammonium nitrate in not a listed substance under this rule.

- A separate EPA program, known as Tier II, requires reporting of hazardous chemicals (ammonium nitrate is included) stored above certain quantities. Tier II reports are submitted to local fire departments and emergency planning and response groups to help them plan for and respond to chemical disasters. In Texas, the reports are collected by the Department of State Health Services. As mentioned earlier, 2012 Tier II reporting data indicate that West Fertilizer filed a Tier II report stating that it had a capacity to store 540,000 lbs of ammonium nitrate at the facility.[11]

It could be argued that if the West Fertilizer facility had been regulated under Section 311 and 312 of EPCRA, the employees, fire responders and the community would have been more aware of the hazards of ammonium nitrate and consequences thereof. However, that argument is contingent on other factors including the fact that there is an operational and effective local emergency planning committee (LEPC) and other federal, state, and local government coordination.

The West Fertilizer facility last submitted a Risk Management Plan under the EPA Risk Management rule in June 30, 2011. In 2006, the EPA fined West Fertilizer Company with $2,300 for not having a risk-management plan that was up to federal standards. [12] [13]

DHS Regulations

Within DHS, two regulations apply to the West Fertilizer facility. Appendix C provides a more detailed discussion on potential coverage/oversight of West Fertilizer by DHS regulations and the regulatory requirements.

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[11] http://www.chicagotribune.com/news/sns-rt-us-usa-explosion-regulationbre93k09h-20130421,0,7972342.story?page=2

[12] http://www.wfaa.com/news/texas-news/Documents-show-West--203543061.html
http://www.washingtonpost.com/blogs/wonkblog/wp/2013/04/18/the-texas-fertilizer-plant-explosion-is-horrific-but-how-common-is-this/

[13] http://keranews.org/post/epa-fined-west-fertilizer-plant-2006

One of the DHS regulations that may have applied to West Fertilizer has not been finalized yet and comes under the congressional statute, ***Section 563, Subtitle J, Secure Handling of Ammonium Nitrate Public Law 110-161***. As implied, this regulation primarily deals with the control of purchase and sales of ammonium nitrate. The other DHS regulation that applies to West Fertilizer is the Chemical Facility Anti-Terrorism Standard (CFATS).

It has been widely reported that West Fertilizer did not file a Top Screen report with DHS as required under the CFATS regulation. The facility was not inspected by DHS for compliance with the CFATS requirements, given its anticipated tier that may not have happened as of today.

DOT Regulations

West Fertilizer was covered by DOT regulations. Please see Appendix D for more details on the regulatory requirements for DOT.

All DOT requirements for ammonium nitrate are with regard to safe transportation. The last known inspection of the West Fertilizer site was conducted by DOT on September 23, 2011. The inspection resulted in a fine of $5,250 with a total of 2 violations; illegible data on ASME placards and/or missing flammable gas placards (front and/or rear) and no security plan.[14] [15] [16] All the penalties/fines were with regard to anhydrous ammonia.

ATF Regulations

Appendix E provides a more detailed description of the ATF regulatory requirements pertaining to ammonium nitrate. In summary, ATF regulations do not apply to ammonium nitrate used as fertilizer. However, ATF has embarked on several collaborative programs with industry organizations to improve security and safety at all ammonium nitrate facilities.

Conclusions and Recommendations

The incidents at West, Texas, and Geismar, Louisiana, are tragedies that could and should have been avoided. However, as I have stated before, this requires continued and committed efforts by all stakeholders. We in the academic community have embarked on some ground-breaking initiatives, but I will be the first one to admit that we have not done enough and we need to do more. So, with that caveat, please understand that when I criticize other stakeholders, I am happy to take criticism myself as well.

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[14] Inspection / Investigation Report No. 1220047. http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Press%20Releases/west_fertilizer_rpt_redact.pdf

[15] Compromise order. http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Hazmat/Enforcement/West%20Fertilizer%20Comp%20Order%20Jun%202012.pdf

[16] Notice of Probable Violation. http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Hazmat/Enforcement/West%20Fertilizer%20NOPV%20Jan2012.pdf

So, what should we do in the aftermath of the incidents in West, Texas, and Geismar, Louisiana? Clearly, as I have stated before, all stakeholders need to look at what they can do. However, this hearing is about the federal oversight programs on risk management and emergency planning. So, my conclusions and recommendations are primarily focused on that aspect.

1. Establishment of a national chemical incident surveillance system for process safety incidents. There is presently no reliable means for evaluating the performance of industry in limiting the number and severity of accidental chemical releases. There is also limited data with which to prioritize efforts to reduce the risks associated with such releases. Without this information, there are no means to measure the effectiveness of present programs or to guide future efforts.

2. Development of incident databases and lessons learned. This knowledge base could then be used to improve planning, response capability, and infrastructure changes. Recent experience in this regard is the improvement in planning and response for hurricane Rita from lessons learned from hurricane Katrina.

3. As a nation, we need to understand if regulations are doing what we intend them to do. To do that, we must understand the issues and to what agency to turn to find a solution. I strongly urge the US Congress to mandate a risk-based study to determine the hazards/risks and develop a regulatory map of hazardous materials oversight. This study should take into consideration types of facilities, their locations, chemicals involved and their quantities in order to determine what agencies do or do not regulate these facilities.

4. All federal agencies with responsibility to regulate safety/risk and associated issues should be required to conduct a primary screening to determine their regulatory landscape. Inter-agency training and briefings with regard to what each agency is covering and how they are enforced would also be beneficial.

5. Once the regulatory landscape is determined in item (4) above, each federal agency should be charged with developing a plan and schedule for ensuring compliance through regular inspections.

6. Inspections can only yield positive results when an adequate number of qualified, trained and competent inspectors is available. Clearly, in these days of budget restrictions, hiring and training hundreds or thousands more inspectors is going to be a challenge at least and at worst impossible. A cost-effective and viable alternative is third-party certified audits and inspections mentioned in item (7) below.

7. Congress should consider directing federal agencies to create verifiable and certified third-party auditing and inspection systems. This approach has worked for ISO-9000 certifications and other programs. There are market-based approaches through which this regime can be implemented without causing a major burden on the regulatory authority or the regulated community. For example, refer to the studies done by the University of Pennsylvania's Risk Management and Decision Processes Center regarding third-party

audits and inspections for EPA's Risk Management Program[17] and Environmental Programs[18].

8. I believe that EPCRA Sections 301-303 provide a systematic framework for coordination of hazard information, prevention programs, and emergency planning and response involving the federal government, state emergency response commissions (SERC) and the local emergency planning committees (LEPC). However, because of a lack of systematic funding and operational capability, most LEPC's are dysfunctional or exist in name only. Some further examination into better communication between the federal and state partners is needed. I urge Congress to look into ways to solve this problem and utilize the LEPC framework in an effective manner.

9. The fact that a nursing home, schools, residential neighborhoods, and other public facilities were so near the blast zone in the West Fertilizer incident raises questions about zoning and land-use planning. I urge the US Congress to look into ways to encourage states and local governments to improve and enforce risk-based zoning and land-use planning.

Summary

I applaud the US Congress for providing leadership in this important area of risk management and emergency planning programs to prevent and address chemical threats. We have made a lot of progress in moving forward to overcome the challenges we face in using chemicals to improve our lives without hurting the industry employees, the public, and the environment. We all can agree that chemicals do improve our lives but we also can agree that they can hurt us too and I as have often said, if we do not do the right things, they can make us extinct as well. This is a serious matter and I am pleased that people at the highest level of government are involved at looking at this matter.

I am encouraged by the leadership of Congress and by continued efforts to seek expertise and opinion from all stakeholders.

[17] http://opim.wharton.upenn.edu/risk/library/2001_JCB_3rdPartyAudits.pdf
[18] http://opim.wharton.upenn.edu/risk/downloads/archive/arch272.pdf

APPENDIX A

Potential Coverage/Oversight of West Fertilizer by OSHA Regulations

The Occupational Safety and Health Administration (OSHA) has general and specific regulations that would apply to the use and possession of Ammonium Nitrate (AN). General requirements include the "General Duty Clause" of the Occupational Safety and Health Act (P.L. 91-596, as amended) and an Emergency Action Plan (EAP) according to OSHA Standard 1910.38[19]. The "General Duty Clause" requires employers to provide employees with a workplace that is free from *"recognized hazards that are causing or are likely to cause death or serious physical harm"*[20]. The Emergency Action Plan must have, at minimum, the following elements[21]:

- procedures for reporting a fire or other emergency;
- procedures for evacuation;
- procedures to be followed by employees who remain to operate parts of the facilities before evacuating;
- procedures to account for all employees after evacuation;
- procedures for employees performing rescue or medical duties; and
- names and job titles of persons who may be contacted by employees to provide information to employees about the EAP

The Risk Management Plan submitted by West Fertilizer Company to the US Environmental Protection Agency states that the company had an EAP[22]. However, the EAP is not publicly available.

Other specific regulations from OSHA that might potentially cover operations at the West, Texas facility include the following:

29 CFR 1910.109: Explosives and Blasting Agents[23]

Brief summary of regulation

This standard regulates the storage, use and transportation of explosives and blasting agents, including mixtures of fuel and oxidizers, *e.g.*, mixtures that might contain ammonium nitrate. Following is the definition of a blasting agent, according to OSHA Standard 1910.109:

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[19] Shea, D.A., Schierow, L.J., Szymendera, S. (2013) Congressional Research Service. *Regulation of Fertilizers: Ammonium Nitrate and Anhydrous Ammonia.*

[20] 29 U.S.C. §654(a). Available at: http://www.gpo.gov/fdsys/pkg/USCODE-2010-title29/pdf/USCODE-2010-title29-chap15-sec654.pdf

[21] 29 C.F.R. §1910.38(c). Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9726&p_table=STANDARDS

[22] West Fertilizer Company Risk Management Plan, available at http://www.rtknet.org/db/rmp/rmp.php?facility_id=100000135597&datype=T&reptype=f&detail=4&submit=GO

[23] 29 C.F.R. §1910.109. Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9755&p_table=STANDARDS

> ***1910.109(a)(1)*** *– "Blasting agent - any material or mixture, consisting of a* <u>*fuel and oxidizer*</u>*, intended for blasting, not otherwise classified as an explosive and in which none of the ingredients are classified as an explosive, provided that the finished product, as mixed and packaged for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined."*

Section **1910.109(g)**, which addresses "blasting agents", specifically makes reference to ammonium nitrate handling in mixing facilities, and it provides recommended separation distances of ammonium nitrate and blasting agents from explosives or blasting agents.

In addition, section **1910.109(i)** provides specific requirements for the storage of ammonium nitrate – but does not apply to transportation. The following paragraphs are taken from OSHA Standard 1910.109:

> ***1910.109(i)(1)(i)(a) –*** *"Except as provided in paragraph (i)(1)(i)(d) of this paragraph applies to the storage of ammonium nitrate in the form of crystals, flakes, grains, or prills including fertilizer grade, dynamite grade, nitrous oxide grade, technical grade, and other mixtures containing 60 percent or more ammonium nitrate by weight but does not apply to blasting agents."*

> ***1910.109(i)(1)(ii)(b) –*** *"The standards for ammonium nitrate (nitrous oxide grade) are those found in the "Specifications, Properties, and Recommendations for Packaging, Transportation, Storage, and Use of Ammonium Nitrate", available from the Compressed Gas Association, Inc., which is incorporated by reference as specified in Sec. 1910.6".*

Compliance Requirements

> ***1910.109(i)(2)(i)*** *– "This paragraph applies to all persons storing, having, or keeping ammonium nitrate, and to the owner or lessee of any building, premises, or structure in which ammonium nitrate is stored in quantities of 1,000 pounds or more."*

> ***1910.109(i)(2)(ii) – "****Approval of large quantity storage shall be subject to due consideration of the fire and explosion hazards, including exposure to toxic vapors from burning or decomposing ammonium nitrate."*

Some of the specific requirements for the storage of ammonium nitrate, among others, which West Fertilizer Company should have complied with are the following:

> ***1910.109(i)(2)(iii)(a)*** *– "... Storage buildings shall not be over one story in height."*

> ***1910.109(i)(2)(iii)(b)*** *– "Storage buildings shall have adequate ventilation or be of a construction that will be self-ventilating in the event of fire."*

1910.109(i)(2)(iii)(c) *– "The wall on the exposed side of a storage building within 50 feet of a combustible building, forest, piles of combustible materials and similar exposure hazards shall be of fire-resistive construction…"*

1910.109(i)(2)(iii)(e) *– "The continued use of an existing storage building or structure not in strict conformity with this paragraph may be approved in cases where such continued use will not constitute a hazard to life."*

1910.109(i)(2)(iii)(f) *– "Buildings and structures shall be dry and free from water seepage through the roof, walls, and floors."*

1910.109(i)(4)(i)(a) – *"Warehouses shall have adequate ventilation or be capable of adequate ventilation in case of fire."*

1910.109(i)(7)(ii)(b) – *"Water supplies and fire hydrants shall be available in accordance with recognized good practices."*

Some of the requirements are summarized in the following table:

Description	**OSHA 1910.109 Requirement**
Piles size	H: 20 ft (6.1 m) W: 20 ft (6.1 m) L: 50 ft (15.2 m)
Piles – walls distance	30 inches (0.762 m)
Pile – roof distance	36 inches (0.91 m)
Pile – pile distance	3 ft (0.91 m)
Storage buildings requirements	The **wall** on the exposed side of a storage building within 50 ft of a combustible building = **fire resistant**
Contaminants	Include, but it is not limited to animal fats, baled cotton, baled rags, baled scrap paper, bleaching powder, burlap or cotton bags, caustic soda, coal, coke, charcoal, cork, camphor, excelsior, fibers of any kind, fish oils, fish meal, foam rubber, hay, lubricating oil, linseed oil, or other oxidizable or drying oils, naphthalene, oakum, oiled clothing, oiled paper, oiled textiles, paint, straw, sawdust, wood shavings, or vegetable oils.

Standard 1910.1200: Hazard Communication[24]

Brief summary of regulation

The goal of this standard is to ensure that employers provide employees adequate information about the hazards of all substances handled at the facility. West Fertilizer Company was covered under this regulation, according to the following paragraph taken from the standard:

> ***1910.1200(b)(2) –*** *"This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency."*

Compliance requirements

The West facility was required to comply with the following requirements (among others) under OSHA's hazard communication standard:

> ***1910.1200(a)(2) –*** *"Classifying the potential hazards of chemicals and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for*
>
> - *developing and maintaining a written hazard communication program for the workplace,*
> - *including lists of hazardous chemicals present;*
> - *labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces;*
> - *preparation and distribution of safety data sheets to employees and downstream employers; and*
> - *development and implementation of employee training programs regarding hazards of chemicals and protective measures."*
>
> ***1910.1200(d)(1) –*** *"Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to classify the chemicals in accordance with this section. For each chemical, the chemical manufacturer or importer shall determine the hazard classes, and, where appropriate, the category of each class that apply to the chemical being classified. Employers are not required to classify chemicals unless they choose not to rely on the classification performed by the chemical manufacturer or importer for the chemical to satisfy this requirement."*

The written hazard communication program should include the following:

> ***1910.1200(e)(1) –*** *"…at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, safety data sheets, and employee information and training will be met, and which also includes the following:*

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[24] 29 C.F.R. §1910.1200.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10099

- A list of the hazardous chemicals known to be present using a product identifier that is referenced on the appropriate safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

- The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas."

Standard 1910.119: Process Safety Management of Highly Hazardous Chemicals[25]

Brief summary of regulation
The Process Safety Management (PSM) standard *"contains requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals"* [26]. Even though West Fertilizer stored ammonia in excess of the threshold specified for ammonia in the PSM standard, this regulation did not apply to West Fertilizer Company, because of the exemption granted to retail facilities.

Compliance Requirements for facilities covered by the PSM standard
Companies covered under the PSM standard must develop and implement a program covering the following 14 elements:

- Employee Participation
- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Contractor Safety
- Pre-Startup Safety Review
- Mechanical Integrity
- Hot Work Program
- Management of Change
- Incident Investigation
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

[25] 29 C.F.R. §1910.119. Available at:
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9760
[26] 29 C.F.R. §1910.119.

APPENDIX B
Potential Coverage/Oversight of West Fertilizer by EPA Regulations

The US Environmental Protection Agency (EPA) is authorized to regulate production, distribution, storage, and release of most chemicals in commerce. The Emergency Planning and Community Right to Know Act (EPCRA) and Section 112(r) of the Clean Air Act (CAA) directly address the potential risks from facilities holding chemical hazards[27]. *Both EPCRA and the CAA section 112(r) Risk Management Program encourage communication between facilities and the surrounding communities about chemical safety and chemical risks*[28].

The Emergency Planning and Community Right-to-Know Act (EPCRA)
EPCRA has four major provisions[29]:

- *Emergency planning (sections 301-303),Office of Emergency Management Factsheet EPCRA September 2012*
- *Emergency release notification (section 304),*
- *Hazardous chemical storage reporting requirements (sections 311-312), and*
- *Toxic chemical release inventory (section 313).*

*EPCRA, **Section 311**, requires owners or operators of local facilities covered by the Occupational Safety and Health Act to submit a material safety data sheet (MSDS) for each "**hazardous chemical**," or a list of such chemicals, to the SERC, the LEPC, and the local fire department.*

*EPCRA, **Section 312**, requires the same employers to submit annually an emergency and hazardous chemical inventory form to the SERC, LEPC, and local fire department. These forms must provide estimates of:*
- *Maximum amount of the chemicals present at the facility at any time during the preceding year*
- *Average daily amount of chemicals present*
- *General location of the chemicals in the facility*

The West Fertilizer facility was exempt from the EPCRA requirements because of exemptions granted to retail fertilizer facilities. EPCRA Section 311(e)(5) excludes certain substances, including "fertilizer held for sale by a retailer to the ultimate customer."[30] [31]

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[27] Shea, D., Schierow, L. and Szymendera, S. (2013). Regulation of Fertilizers: Ammonium Nitrate and Anhydrous Ammonia. CRS Report for Congress. Available at: http://www.fas.org/sgp/crs/homesec/R43070.pdf
[28] How LEPCs and Other Local can include information from RMP in their ongoing work: http://www.epa.gov/oem/docs/chem/lepc-rmp.pdf
[29] What Does EPCRA Cover: http://www.epa.gov/oem/docs/chem/epcra.pdf
[30] Exemptions under Sections 311 and 312: http://www.epa.gov/osweroe1/content/epcra/epcra-qa_exempt_311.htm#s311e5_4
[31] http://emergencymanagement.supportportal.com/link/portal/23002/23016/Article/13919/Are-farm-suppliers-and-retailers-exempt-from-311-and-312

Section 112(r) of the Clean Air Act[32]

Background

- *The Act requires EPA to promulgate an initial list of at least 100 substances that, in the event of an accidental release*[33]*, are known to cause or may reasonably be anticipated to cause death, injury, or serious adverse effects to human health or the environment*[34]*.*
- *In developing this list, EPA was required to consider, but was not limited to, the list of extremely hazardous substances (EHSs) promulgated under EPCRA (SARA Title III) section 302. EPA did not propose to adopt the entire EHS list because it includes a number of* ***solids and non-volatile liquids*** *for which an effect beyond the fenceline in the event of an accidental release is expected to be less likely than for gaseous or volatile liquids*[35]*.*
- *Congress listed the following 16 substances to be included in the initial list (Chlorine,* ***ammonia and anhydrous ammonia****, methyl chloride, ethylene oxide, vinyl chloride, methyl isocyanate, hydrogen cyanide, hydrogen sulfide, toluene diisocyanate, phosgene, bromine, anhydrous hydrogen chloride, hydrogen fluoride, anhydrous sulfur dioxide, and sulfur trioxide).*
- *Explosive materials (Division 1.1. under DOT classification) were initially included in the list of highly hazardous materials when the EPA regulation was developed. However, explosive materials were delisted*[36] *in 1998 with the proviso that ATF covered all the aspects that are necessary under RMP, except for public disclosure*[37]*. The industry voluntarily agreed to make that public disclosure that makes it equivalent to RMP.*

The West Fertilizer facility was covered under Program 2 of the EPA Risk Management Program because of ammonia. However, ammonium nitrate is not included in the covered list and West Fertilizer would not have had to report any analysis or calculations regarding ammonium nitrate in their submissions to EPA.

Table B-1 shows a summary of the criteria used by EPA for determining extremely hazardous materials and the corresponding thresholds to be covered under the RMP rule. Based Table B-1, ammonium nitrate is not covered by the RMP rule because ammonium nitrate does not meet the requirements to be considered as toxic or flammable.

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[32] Clean Air Act Section 112(r): Accidental release prevention/RMP Rule: http://www.epa.gov/osweroe1/docs/chem/caa112_rmp_factsheet.pdf

[33] Based on CAA Section 112(r)(2)(A): An accidental release is defined as "an unanticipated emission...into the ambient air from a stationary source."

[34] EPA list of regulated substances and thresholds: http://www.ncair.org/112r/files/40cfr68(9&68)_01141994.pdf

[35] EPA list of regulated substances and thresholds (pag 19): http://www.ncair.org/112r/files/40cfr68(9&68)_01141994.pdf

[36] RMP rule amendments: http://www.epa.gov/R5Super/cepps/pdfs/applicability-faq-200405.pdf

[37] RMP hearing. March 1999: http://books.google.com/books?id=oyy7IP0X3lAC&pg=PA18&lpg=PA18&dq=rmp+include+explosives?&source=bl&ots=hPVRLfJ49y&sig=3lguj7tddGoZH6Y05IkyagjetwM&hl=en&sa=X&ei=rtrEUYDvE9KJrQGV3IGIDw&ved=0CEcQ6AEwAw#v=onepage&q=rmp%20include%20explosives%3F&f=false

Table B-1. Summary of categories and thresholds of extremely hazardous materials[38]:

Categories	Requirements	Threshold quantities (lb)*
77 Toxic substances	*Acute toxicity:* - Inhalation: LC50 = 0.5 mg/L or - Dermal: LD50 = 50 mg/kg of body weight, or - Oral: LD50 = 25 mg/kg of body weight *Vapor pressure* >10 mmHg *Accident history*	500 – 20,000
63 Flammable substances	FP < 73 ^{o}F (22.8 ^{o}C) BP < 100 ^{o}F (37.8 ^{o}C)	10,000

*Substances in mixtures would be exempted from the threshold determination if they represent less than one percent of the mixture by weight. (EPA List of Regulated Substances is found in reference 39)[39].

- **Listing criteria:**
  - ***Toxicity:*** *Listed toxic substances are expected to rapidly become airborne, thus human exposure by the inhalation route is of primary concern. The listing criteria established for toxic substances considers not only acute toxicity, but also physical/chemical properties (physical state, vapor pressure), and accident history.*
    The acute toxicity criteria:
    (a) Inhalation LC50 0.5 milligrams per liter of air (for exposure time 8 hours), or
    (b) Dermal LD50 50 milligrams per kilogram of body weight, or
    (c) Oral LD50 25 milligrams per kilogram of body weight.

    Vapor pressure cut off:
    Initially, a vapor pressure criterion of ***0.5 mm Hg*** *was used as a baseline, based on the vapor pressure of toluene diisocyanate, a substance mandated for the initial list by Congress. However, EPA considered that this low vapor pressure level may lead to an overly conservative listing of chemicals that pose a relatively lower potential for air releases. Then,* ***EPA decided to set the vapor pressure criterion at the higher level of 10 mm Hg****. Substances with pressures above 10 mm Hg are likely to be volatilized and released, even after a timely facility response occurs, potentially causing off-site impacts.*

    Accident history:
    Substances that "are known to cause ... death, injury, or serious adverse effects on human health or the environment" may be included on the list under section 112(r)(3).

  - ***Flammable gases and volatile flammable liquids:*** *Based on the flash point (FP) and boiling point (BP) criteria used by NFPA. Based on both accident reports and modeling*

[38] EPA list of regulated substances and thresholds: http://www.ncair.org/112r/files/40cfr68(9&68)_01141994.pdf
[39] http://www.epa.gov/R5Super/cepps/pdfs/rmp-listed-chemicals-200708.pdf

results, EPA considered that flammable substances that meet the listing criteria, in quantities above the threshold quantity of 10,000 lb, could present a hazard to the public from a vapor cloud explosion.
OSHA's PSM Standard provides an exemption for flammable liquids kept in atmospheric tanks below their normal boiling point. Unlike OSHA, EPA considers these substances to be intrinsically hazardous, regardless of conditions of storage, and, therefore, no exemption is provided in those cases.

Requirements if ammonium nitrate were covered by CAA 112:
EPA defined three "program levels" to ensure that individual chemical processes are subject to appropriate requirements based on the size of the process and the associated risks [40].

- **Program 1 eligibility (provided in section § 68.10) [41].**

1. *For the five years prior to the submission of an RMP, the process has not had an accidental release of a regulated substance where exposure to the substance, its reaction products, overpressure generated by an explosion involving the substance, or radiant heat generated by a fire involving the substance led to any of the following offsite: (i) Death; (ii) Injury; or (iii) Response or restoration activities for an exposure of an environmental receptor.*
2. *The distance to a toxic or flammable endpoint for a worst-case release assessment conducted under Subpart B and § 68.25 is* ***less than the distance to any public receptor****, as defined in § 68.30.*
3. *Emergency response procedures have been coordinated between the stationary source and local emergency planning and response organizations.*

- **Program 1 requirements (provided in section § 68.12):**

1. *Analyze the worst-case release scenario for the process(es), as provided in § 68.25; document that the nearest public receptor is beyond the distance to a toxic or flammable endpoint defined in § 68.22(a); and submit in the RMP the worst-case release scenario as provided in § 68.165;*
2. *Complete the five-year accident history for the process as provided in § 68.42 of this part and submit it in the RMP as provided in § 68.168;*
3. *Ensure that response actions have been coordinated with local emergency planning and response agencies; and*
4. *Certify in the RMP the following: Based on the criteria in 40 CFR 68.10, the distance to the specified endpoint for the worst-case accidental release scenario for the following process(es) is less than the distance to the nearest public receptor: Within the past five years, the process(es) has (have) had no accidental release that caused offsite impacts provided in the risk management program rule (40 CFR 68.10(b)(1)).*

- **Program 2 eligibility (provided in section § 68.10):**

A covered process is subject to Program 2 requirements if it does not meet the eligibility requirements of program 1 and 3.

- **Program 2 requirements (provided in section § 68.12):**

1. *Develop and implement a management system as provided in § 68.15;*
2. *Conduct a hazard assessment as provided in Sec.§ 68.20 through 68.42;*

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[40] RMP requirements: http://www.epa.gov/emergencies/docs/chem/clean_air_guidance.pdf
[41] APPENDIX A. 40 CFR 68(pag 9): http://www.epa.gov/osweroe1/docs/chem/Appendix-A-final.pdf

3. *Implement the Program 2 prevention steps provided in Sec.§ 68.48 through 68.60 or implement the Program 3 prevention steps provided in Sec.§ 68.65 through 68.87;*

- **Program 3 eligibility (provided in section § 68.10):**

A covered process is subject to Program 3 if the process does not meet the requirements of program 1 of this section, and if either of the following conditions is met:

1. *The process is in NAICS code 32211, 32411, 32511, 325181, 325188, 325192, 325199, 325211, 325311, or 32532;* ***or***
2. *The process is subject to the OSHA process safety management standard, 29 CFR 1910.119.*

- **Program 3 requirements (provided in section § 68.12):**

1. *Develop and implement a management system as provided in § 68.15;*
2. *Conduct a hazard assessment as provided in Sec.§ 68.20 through 68.42;*
3. *Implement the prevention requirements of Sec.§ 68.65 through 68.87;*
4. *Develop and implement an emergency response program as provided in Sec.§ 68.90 to 68.95 of this part; and*
5. *Submit as part of the RMP the data on prevention program elements for Program 3 processes as provided in § 68.175.*

Figure B-1 can be used to identify the program level. In general, the requirements under the RMP rule include development of a hazard assessment, a prevention program, and an emergency response program.[42]

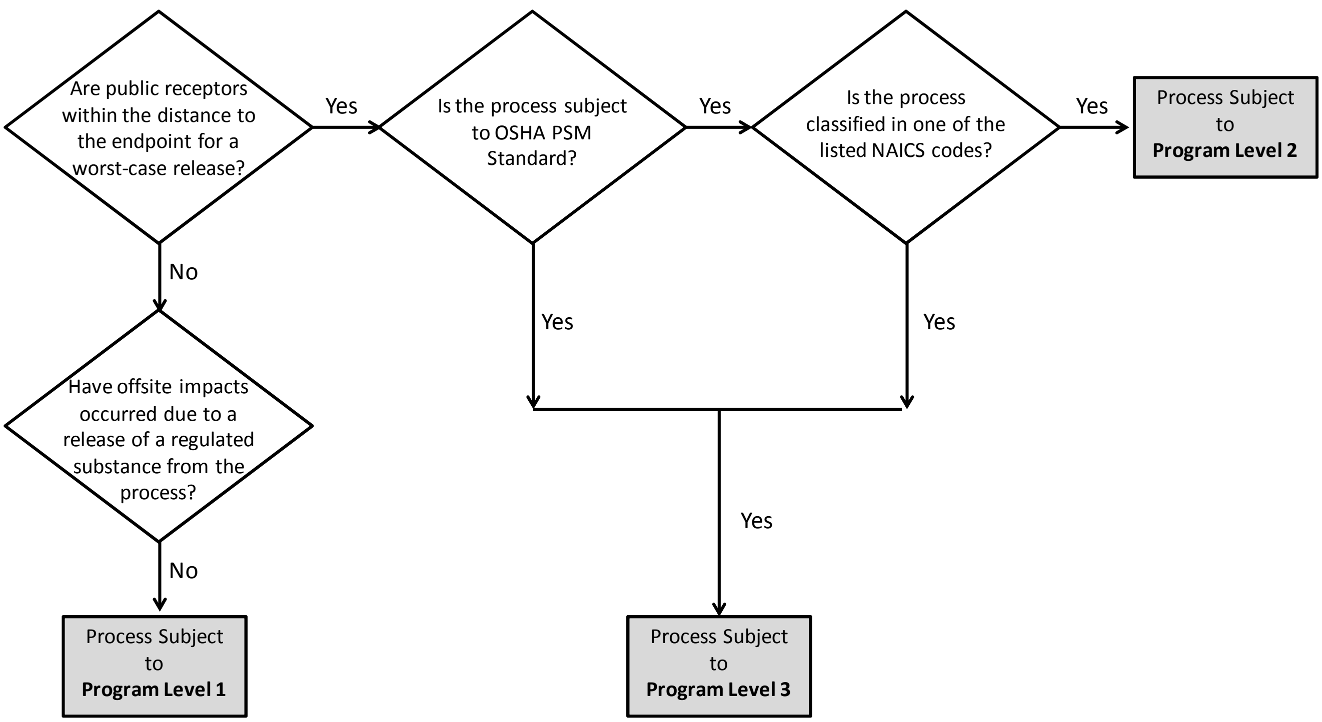

Fig. B-1. Diagram of the decision rules on determining Program level[43]

[42] http://www.epa.gov/osweroe1/docs/chem/ammonitr.pdf
[43] Decision rules on determining EPA Program level: http://www.epa.gov/osweroe1/docs/chem/Chap-02-final.pdf

Based on the eligibility criteria, West Fertilizer Company would not be included in Program 1 because the distance to a toxic or flammable endpoint for a worst-case release assessment is greater than the distance to any public receptor.

The West Fertilizer facility would not be included in Program 3 because the company NAICS code (42451-Facility grain and field bean merchant wholesalers) is not listed in the Program 3 eligibility requirements AND the West Fertilizer facility is excluded from the PSM program because of the retail exemption.

Hence, the West Fertilizer facility would be covered by Program 2 of the EPA Risk Management Program, but only because of the storage of ammonia.

APPENDIX C

Potential Coverage/Oversight of West Fertilizer by DHS Regulations

With regard to ammonium nitrate, DHS regulations include the proposed rule regulating the control of the purchase and the sales of AN (Section 563) and the Chemical Facility Anti-Terrorism Standards (CFATS). To-date, DHS has not published the final rule mandated under the congressional statute (Section 563) summarized below. CFATS regulation is administered by DHS, and the requirements under CFATS are also discussed in this Appendix.

Section 563, Subtitle J, Secure Handling of Ammonium Nitrate Public Law 110-161
Section 563 of the 2008 Consolidated Appropriations Act, Subtitle J, Secure Handling of Ammonium Nitrate ("Section 563"), Public Law 110-161,[44] requires the Department of Homeland Security to "regulate the sale and transfer of ammonium nitrate by an ammonium nitrate facility ... to prevent the misappropriation or use of ammonium nitrate in an act of terrorism." [45]

''Subtitle J—Secure Handling of Ammonium Nitrate

SEC. 899A. DEFINITIONS.
SEC. 899B. REGULATION OF THE SALE AND TRANSFER OF AMMONIUM NITRATE.
SEC. 899C. INSPECTION AND AUDITING OF RECORDS.
SEC. 899D. ADMINISTRATIVE PROVISIONS.
SEC. 899E. THEFT REPORTING REQUIREMENT.
SEC. 899F. PROHIBITIONS AND PENALTY.
SEC. 899G. PROTECTION FROM CIVIL LIABILITY.
SEC. 899H. PREEMPTION OF OTHER LAWS.
SEC. 899I. DEADLINES FOR REGULATIONS.
SEC. 899J. AUTHORIZATION OF APPROPRIATIONS."

For example, SEC. 899B, states:
"SEC. 899B. REGULATION OF THE SALE AND TRANSFER OF AMMONIUM NITRATE.
(a) IN GENERAL.—The Secretary shall regulate the sale and transfer of ammonium nitrate by an ammonium nitrate facility in accordance with this subtitle to prevent the misappropriation or use of ammonium nitrate in an act of terrorism.
(b) AMMONIUM NITRATE MIXTURES.—Not later than 90 days after the date of the enactment of this subtitle, the Secretary, in consultation with the heads of appropriate Federal departments and agencies (including the Secretary of Agriculture), shall, after notice and an opportunity for comment, establish a threshold percentage for ammonium nitrate in a substance.
(c) REGISTRATION OF OWNERS OF AMMONIUM NITRATE FACILITIES.—
(1) REGISTRATION.—The Secretary shall establish a process by which any person that—

[44] 2008 Consolidated Appropriations Act, Subtitle J, Secure Handling of Ammonium Nitrate ("Section 563", Public Law 110–161) http://www.gpo.gov/fdsys/pkg/PLAW-110publ161/pdf/PLAW-110publ161.pdf
[45] http://www.dhs.gov/ammonium-nitrate-security-statutes-and-regulations

(A) owns an ammonium nitrate facility is required to register with the Department; and

(B) registers under subparagraph (A) is issued a registration number for purposes of this subtitle.

(2) REGISTRATION INFORMATION.—Any person applying to register under paragraph (1) shall submit to the Secretary—

(A) the name, address, and telephone number of each ammonium nitrate facility owned by that person;

(B) the name of the person designated by that personas the point of contact for each such facility, for purposes of this subtitle; and

(C) such other information as the Secretary may determine is appropriate.

(d) REGISTRATION OF AMMONIUM NITRATE PURCHASERS.—

(1) REGISTRATION.—The Secretary shall establish a process by which any person that—

(A) intends to be an ammonium nitrate purchaser is required to register with the Department; and

(B) registers under subparagraph (A) is issued a registration number for purposes of this subtitle.

(2) REGISTRATION INFORMATION.—Any person applying to register under paragraph (1) as an ammonium nitrate purchaser shall submit to the Secretary—

(A) the name, address, and telephone number of the applicant; and

(B) the intended use of ammonium nitrate to be purchased by the applicant.

(e) RECORDS.—

(1) MAINTENANCE OF RECORDS.—The owner of an ammonium nitrate facility shall—

(A) maintain a record of each sale or transfer of ammonium nitrate, during the two-year period beginning on the date of that sale or transfer; and

(B) include in such record the information described in paragraph (2).

(2) SPECIFIC INFORMATION REQUIRED.—For each sale or transfer of ammonium nitrate, the owner of an ammonium nitrate facility shall—

(A) record the name, address, telephone number, and registration number issued under subsection (c) or (d) of each person that purchases ammonium nitrate, in a manner prescribed by the Secretary;

(B) if applicable, record the name, address, and telephone number of an agent acting on behalf of the person described in subparagraph (A), at the point of sale;

(C) record the date and quantity of ammonium nitrate sold or transferred; and

(D) verify the identity of the persons described in subparagraphs (A) and (B), as applicable, in accordance with a procedure established by the Secretary.

(3) PROTECTION OF INFORMATION .—In maintaining records in accordance with paragraph (1), the owner of an ammonium nitrate facility shall take reasonable actions to ensure the protection of the information included in such records.

(f) EXEMPTION FOR EXPLOSIVE PURPOSES .—The Secretary may exempt from this subtitle a person producing, selling, or purchasing ammonium nitrate exclusively for use in the production of an explosive under a license or permit issued under chapter 40 of title 18, United States Code.

(g) CONSULTATION .—In carrying out this section, the Secretary shall consult with the Secretary of Agriculture, States, and appropriate private sector entities, to ensure that the access of agricultural producers to ammonium nitrate is not unduly burdened.

(h) DATA CONFIDENTIALITY .—……
(i) REGISTRATION PROCEDURES AND CHECK OF TERRORIST SCREENING DATABASE .—

(1) REGISTRATION PROCEDURES .—

(A) GENERALLY .—The Secretary shall establish procedures to efficiently receive applications for registration numbers under this subtitle, conduct the checks required under paragraph (2), and promptly issue or deny a registration number.

(B) INITIAL SIX -MONTH REGISTRATION PERIOD .—The Secretary shall take steps to maximize the number of registration applications that are submitted and processed during the six-month period described in section 899F(e).

(2) CHECK OF TERRORIST SCREENING DATABASE .—

(A) CHECK REQUIRED .—The Secretary shall conduct a check of appropriate identifying information of any person seeking to register with the Department under subsection (c) or (d) against identifying information that appears in the terrorist screening database of the Department."

Chemical Facility Anti-Terrorism Standards (CFATS)

CFATS addresses hundreds of chemicals, including ammonium nitrate, and is directed at the security of high-risk facilities. DHS stated in the CFATS interim final rule that "if a retail establishment does exceed any of these [screening threshold quantities], *the retail establishment will have to complete the Top-Screen*."[46]

The DHS lists 322 chemicals and screening threshold quantities for each chemical to determine the need to comply with CFATS[47]*. The DHS considers each chemical in the context of three threats: release; theft or diversion; and sabotage and contamination. The regulation lists two formulations of ammonium nitrate (one used as a blasting agent, the other as fertilizer) as a chemical of interest and identifies them as release and theft or diversion threats.*
The screening threshold quantity differs depending on whether the ammonium nitrate is a blasting agent or fertilizer. Facilities having at least 5,000 lbs of AN (400 lbs, if packaged for transportation), as a blasting agent (ammonium nitrate with more than 0.2% combustible substances), or at least 2,000 lbs of transportable fertilizer (with nitrogen concentration of 23% or greater, or fertilizer mixture containing at least 33% of AN) are considered a high risk facility. Therefore, they should follow CFATS[48].

"Assignment of tiers is based on an assessment of the potential consequences of a successful attack on assets associated with chemicals of interest. The Department of Homeland Security uses information submitted by facilities through the Chemical Security Assessment Tool Top Screen and Security Vulnerability Assessment (SVA) processes to identify a facility's risk, which is a function of the potential impacts of an attack (consequences), the likelihood that an attack on

[46] 72 Federal Register 17688-17745 (April 9, 2007) at 17697 (in page 17697, it is the last sentence of "1. Definition of ``Chemical Facility or Facility''", right above "2. Multiple Owners and Operators"). http://www.gpo.gov/fdsys/pkg/FR-2007-04-09/html/E7-6363.htm
[47] DHS list of chemicals: http://www.dhs.gov/xlibrary/assets/chemsec_appendixa-chemicalofinterestlist.pdf
[48] 72 Federal Register 65396-65435 (November 20, 2007) at 65407, http://www.gpo.gov/fdsys/pkg/FR-2007-11-20/html/07-5585.htm

the facility would be successful (vulnerabilities), and the likelihood that such an attack would occur at the facility (threat). All facilities that were individually requested by the Assistant Secretary or that meet the criteria in Appendix A [of CFATS] *must complete the CSAT Top Screen. The highest tier facilities, or Phase 1 facilities, are those specifically requested by the Assistant Security to complete the Top Screen; these are addressed by the Department first. All facilities that must complete the Top Screen are preliminarily tiered. These facilities are required to complete a Security Vulnerability Assessment (SVA), which provides more in-depth information that allows the Department to assign a final risk tier ranking to the facility. Preliminarily tier 1, 2, and 3 facilities must subsequently submit a CSAT Security Vulnerability Assessment. Tier 4 facilities may submit an Alternative Security Program (ASP) for the Department of Homeland Security to consider in accordance with 67 CFR 27.235(a). Tier 3 and 4 facilities may choose to submit an Alternative Security Plan for the Site Security Plan for consideration by the Department in accordance with 6 CFR 27.235(a).”* [49]

Top screen questions:
http://www.dhs.gov/xlibrary/assets/chemsec_csattopscreenquestions.pdf
http://www.dhs.gov/xlibrary/assets/chemsec_csattopscreenusersmanual.pdf

Security Vulnerability Assessment (SVA) questions:
https://www.dhs.gov/sites/default/files/publications/chemicalsecurity_svaquestions%20v3.pdf

[49] http://www.dhs.gov/risk-chemical-facility-anti-terrorism-standards-cfats

APPENDIX D
Potential Coverage/Oversight of West Fertilizer by DOT Regulations

Ammonium nitrate is covered by DOT, according to the following paragraph taken from **§ 173.127**:

"*173.127 Class 5, Division 5.1—Definition and assignment of packing groups. (a) Definition. For the purpose of this subchapter, oxidizer (Division 5.1) means a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials. (1) A solid material is classed as a Division 5.1 material if, when tested in accordance with the UN Manual of Tests and Criteria (IBR, see § 171.7 of this subchapter), its mean burning time is less than or equal to the burning time of a 3:7 potassium bromate/cellulose mixture. (2) A liquid material is classed as a Division 5.1 material if, when tested in accordance with the UN Manual of Tests and Criteria, it spontaneously ignites or its mean time for a pressure rise from 690 kPa to 2070 kPa gauge is less then the time of a 1:1 nitric acid (65 percent)/cellulose mixture."*[50]

All DOT requirements for ammonium nitrate are with regard to safe transportation. Last known inspection of the West Fertilizer site was conducted by DOT on September 23, 2011. The inspection resulted in a fine of $5,250 with a total of 2 violations; illegible data on ASME placards and/or missing flammable gas placards (front and/or rear) and no security plan.[51] [52] [53] All the penalties/fines were with regard to anhydrous ammonia.

"**Section 172.800(b)**[54] states, in part, "*Each person who offers for transportation in commerce or transports in commerce one or more of the following hazardous materials must develop and adhere to a transportation security plan for hazardous materials that conforms to the requirements of this subpart. As used in this section, "large bulk quantity" refers to a quantity greater than 3,000 kg (6,614 pounds) for solids or 3,000 liters (792 gallons) for liquids and gases in a single packaging such as a cargo tank motor vehicle, portable tank, tank car, or other bulk container*."

Section 172.802(b) [55] states *(a) "The security plan must include an assessment of transportation security risks for shipments of the hazardous materials listed in §172.800, including site-specific or location-specific risks associated with facilities at which the hazardous materials listed in*

[50] 49 CFR § 173.127. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title49-vol2/pdf/CFR-2010-title49-vol2-sec173-127.pdf

[51] Inspection / Investigation Report No. 1220047. Available at: http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Press%20Releases/west_fertilizer_rpt_redact.pdf

[52] Compromise order. Available at: http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Hazmat/Enforcement/West%20Fertilizer%20Comp%20Order%20Jun%202012.pdf

[53] Notice of Probable Violation. Available at: http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Hazmat/Enforcement/West%20Fertilizer%20NOPV%20Jan2012.pdf

[54] 49 CFR §172.800. Available at http://www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-sec172-800.pdf

[55] 49 CFR §172.802b. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-sec172-800.pdf

§172.800 *are prepared for transportation, stored, or unloaded incidental to movement, and appropriate measures to address the assessed risks. Specific measures put into place by the plan may vary commensurate with the level of threat at a particular time. At a minimum, a security plan must include the following elements:*

(1) Personnel security. Measures to confirm information provided by job applicants hired for positions that involve access to and handling of the hazardous materials covered by the security plan. Such confirmation system must be consistent with applicable Federal and State laws and requirements concerning employment practices and individual privacy.

(2) Unauthorized access. Measures to address the assessed risk that unauthorized persons may gain access to the hazardous materials covered by the security plan or transport conveyances being prepared for transportation of the hazardous materials covered by the security plan.

(3) En route security. Measures to address the assessed security risks of shipments of hazardous materials covered by the security plan en route from origin to destination, including shipments stored incidental to movement.

(b) The security plan must also include the following:

(1) Identification by job title of the senior management official responsible for overall development and implementation of the security plan;

(2) Security duties for each position or department that is responsible for implementing the plan or a portion of the plan and the process of notifying employees when specific elements of the security plan must be implemented; and

(3) A plan for training hazmat employees in accordance with §172.704 (a)(4) and (a)(5) of this part.

(c) The security plan, including the transportation security risk assessment developed in accordance with paragraph (a) of this section, must be in writing and must be retained for as long as it remains in effect. The security plan must be reviewed at least annually and revised and/or updated as necessary to reflect changing circumstances. The most recent version of the security plan, or portions thereof, must be available to the employees who are responsible for implementing it, consistent with personnel security clearance or background investigation restrictions and a demonstrated need to know. When the security plan is updated or revised, all employees responsible for implementing it must be notified and all copies of the plan must be maintained as of the date of the most recent revision.

(d) Each person required to develop and implement a security plan in accordance with this subpart must maintain a copy of the security plan (or an electronic file thereof) that is accessible at, or through, its principal place of business and must make the security plan available upon request, at a reasonable time and location, to an authorized official of the Department of Transportation or the Department of Homeland Security.”

APPENDIX E

Potential Coverage/Oversight of West Fertilizer by ATF Regulations

The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) regulates ammonium nitrate-based blasting agents. It has regulations on the necessary distance to be maintained between ammonium nitrate and other explosive materials.

Subpart K – Storage§555.202. [56] *Classes of explosive materials.*
"(c) Blasting agents. (For example, ammonium nitrate-fuel oil and certain water-gels (see also § 555.11)."
§ 555.11 Blasting agent. [57] ***"****Any material or mixture, consisting of fuel and oxidizer, that is intended for blasting and not otherwise defined as an explosive; if the finished product, as mixed for use or shipment, cannot be detonated by means of a number 8 test blasting cap when unconfined. A number 8 test blasting cap is one containing 2 grams of a mixture of 80 percent mercury fulminate and 20 percent potassium chlorate, or a blasting cap of equivalent strength. An equivalent strength cap comprises 0.40–0.45 grams of PETN base charge pressed in an aluminum shell with bottom thickness not to exceed to 0.03 of an inch, to a specific gravity of not less than 1.4 g/cc., and primed with standard weights of primer depending on the manufacturer."*

§555.220 Table of separation distances of ammonium nitrate and blasting agents from explosives or blasting agents.

Donor weight (pounds)		Minimum separation distance of acceptor from donor when barricaded (feet)		Minimum thickness of artificial barricades (inches)
Over	Not over	Ammonium nitrate	Blasting agent	
0	100	3	11	12
100	300	4	14	12
300	600	5	18	12
600	1,000	6	22	12
1,000	1,600	7	25	12
1,600	2,000	8	29	12
2,000	3,000	9	32	15
3,000	4,000	10	36	15
4,000	6,000	11	40	15
6,000	8,000	12	43	20
8,000	10,000	13	47	20
10,000	12,000	14	50	20
12,000	16,000	15	54	25
16,000	20,000	16	58	25
20,000	25,000	18	65	25
25,000	30,000	19	68	30
30,000	35,000	20	72	30
35,000	40,000	21	76	30
40,000	45,000	22	79	35
45,000	50,000	23	83	35
50,000	55,000	24	86	35
55,000	60,000	25	90	35
60,000	70,000	26	94	40
70,000	80,000	28	101	40
80,000	90,000	30	108	40
90,000	100,000	32	115	40
100,000	120,000	34	122	50
120,000	140,000	37	133	50
140,000	160,000	40	144	50
160,000	180,000	44	158	50
180,000	200,000	48	173	50
200,000	220,000	52	187	60
220,000	250,000	56	202	60
250,000	275,000	60	216	60
275,000	300,000	64	230	60

Table: National Fire Protection Association (NFPA) Official Standard No. 492, 1968

[56] 555.202 ATF Federal Explosives Law and Regulations (2012) http://www.atf.gov/files/publications/download/p/atf-p-5400-7.pdf
[57] 555.11 ATF Federal Explosives Law and Regulations(2012) http://www.atf.gov/files/publications/download/p/atf-p-5400-7.pdf

555.220 (1)[58] *"This table specifies separation distances to prevent explosion of ammonium nitrate and ammonium nitrate-based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the table as the "donor." Ammonium nitrate, by itself, is not considered to be a donor when applying this table. Ammonium nitrate, ammonium nitrate-fuel oil or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distance of explosives or blasting agents, one-half the mass of the ammonium nitrate is to be included in the mass of the donor."*

However, ATF does not regulate ammonium nitrate as fertilizer because of the exemption in subpart H.

Subpart H- Exemptions §555.141.(a).(8)[59] *"Gasoline,* **fertilizers***, propellant actuated devices, or propellant actuated industrial tools manufactured, imported, or distributed for their intended purposes."*

If ammonium nitrate as fertilizer was covered by ATF, and stored nearby other explosives or other blasting agents, it would be required to be stored in accordance with the above table. In the case of West Fertilizer, no other explosives are stored nearby to the best of our knowledge. Thus, even if ATF regulations had covered ammonium nitrate as fertilizer, the ammonium nitrate in the West Fertilizer facility would not to be required to be stored in accordance with the above table.

[58] 555.220 (1) ATF Federal Explosives Law and Regulations 2012 http://www.atf.gov/files/publications/download/p/atf-p-5400-7.pdf

[59] ATF Federal Explosives Law and Regulations (2012) http://www.atf.gov/files/publications/download/p/atf-p-5400-7.pdf

Testimony of Kim Nibarger, United Steelworkers
Before the
U.S. Senate Committee on Environment and Public Works

Oversight of Federal Risk Management and Emergency Planning Programs to Prevent and Address Chemical Threats, Including the Events Leading Up to the Explosion in West, TX and Geismar, LA

June 27, 2013
Washington, DC

Chairman Boxer, Ranking Member Vitter and members of the committee, thank you for the opportunity to testify at this hearing. My name is Kim Nibarger. I am a health, safety and environmental specialist for the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union, or USW for short. We are the largest and most diverse industrial union in the US. The relevant fact for this hearing is that we represent the majority of organized workers in the petrochemical industry, as well as hundreds of thousands of workers who use chemicals on the job. My own background is in the refining industry; I worked in a West Coast oil refinery for 17 years.

First, I would like to point out that the two events under discussion; the explosions at the West Texas fertilizer plant and the Williams Chemical facility are in no way isolated incidents. On April 17 of this year, 12 workers were burned at the ExxonMobil Beaumont refinery, two of whom subsequently died from their injuries. On April 27, eight workers were sent to the hospital after an explosion and fire at the Chevron Port Arthur refinery. And on this past Monday an explosion at a fertilizer plant in Indiana killed one person.

Since 2008 the oil industry has reported an average of over 45 fires a year; so far 2013 appears to be right on track with 22 fires through the 21st of June. These are industry self-reported and do not include many smaller seal fires or electrical fires that USW members bring to our attention. This also does not include oil rigs, pipelines or storage terminal fires nor does it include fires in chemical plants.

These sometimes deadly and potentially catastrophic events take place all too often in this industry. The first response from industry after a tragedy is that the safety of their employees is their top priority. The widowed wives and children left without a father or mother may feel differently. More must be done to prevent these types of incidents from occurring in the first place.

The USW recently released a study entitled, “A Risk Too Great, Hydrofluoric Acid in U.S. Refineries.” Twenty three USW sites were surveyed, which represent nearly half of the fifty US refineries that use hydrofluoric acid (HF) as a catalyst in the alkylation process.

EPA requires companies using or storing highly toxic chemicals to develop a risk management plan (RMP) in part to gauge how far a worst case release might travel and how many people might be in harm's way. For HF releases from US refineries, the range is three to 25 miles, depending mostly on the amount stored. Twenty-six million people live within the vulnerable zone of these US refineries, many in urban areas like Philadelphia, Memphis, Salt Lake City, and the Houston – Galveston corridor. These locations would be impossible to evacuate quickly in the event of a major release. No other chemical operation puts as many people at risk.

The sites were asked to rate on a descending scale from very effective or very prepared to very ineffective or very unprepared their sites were in taking the necessary steps for maintaining safety in the facility. Questions asked dealt with mechanical integrity, effectiveness of existing safety systems, preparedness of emergency responders, both on and off site. Rarely was the highest level reached. In an alarming number of cases, workers rated the site as unprepared or ineffective.

From this survey, we made seven recommendations to improve safety in these facilities. Two of them, investigate and learn about safer alternatives to HF and pilot test alternative solutions speak to the heart of the problem; there are safer alternatives for manufacturing available.

A pilot project and even conversion is not expensive compared to the possibility of a Macondo-type event at one of these refineries using HF acid. Solid acid catalyst and liquid ionic catalyst are two possible options. They have been piloted successfully and only lack industry's commitment to make the change. But industry has been resistant, citing the cost for conversion. Eight oil companies operate 18 of the study refineries. In total, these eight companies had gross operating profits in 2011 of approximately $150 billion.

The USW also released a survey in October of 2007 of the oil refineries we represent in the US. Following the BP Texas City disaster 70% of the local unions we surveyed reported that their facilities were less than very prepared for emergencies. Time and again we hear from our members that staffing is not adequate on a day to day basis, overtime is excessive and they do not have enough people on the units for emergencies. The companies tell us that they do not staff for emergencies. I cannot think of a more critical situation to be staffing for.

As seen at the West fertilizer plant and the fire last year at the USW-represented Chevron refinery in Richmond California, the events at these facilities can have a far reaching impact on the communities. These potential impacts are the very reason the EPA requires companies to develop a RMP. While the EPA does many plant inspections during a year I would dare say that most of these are air or water inspections as opposed to RMP inspections. To a great extent the limited numbers of inspections are tied to budget and staffing conditions, not unlike what we hear with federal OSHA.

The regulatory process relies on much self-reporting which in essence allows the industry to self-regulate. As seen in the November 2012 EPA RMP inspection report on the ExxonMobil facility in Baton Rouge, 40 CFR (Code of Federal Regulations) 68.79 which addresses Compliance Audits says; "The owner and operator shall certify they have evaluated compliance with the provisions of this subpart at least every three years to verify that procedures and practices developed under this subpart are adequate and are being followed."

The refinery has done two OSHA Process Safety Management (PSM) audits but had never completed a compliance audit for RMP, which are required every three years. In order to assess compliance, EPA reviewed the PSM audits since the regulations are similar. The EPA evaluation found that not only were required elements missing altogether, but even where an element was addressed, the company did not follow the appropriate technical procedures and practices that are required to be reviewed, developed and followed.

One of the problems with the OSHA PSM standard (29CFR 1910.119) which governs the health and safety of facilities using a specified volume of highly hazardous chemicals is that it is performance based. The standard tells you what to do but how it is done is left up to the company. This is necessary to a degree in that it allows the employer to bring in new technology or what is termed recognized and generally accepted good engineering practices (RAGAGEP) to make improvements under the standard. What we typically see are employers riding on past practice as this was RAGAGEP at the time it was put in place, so they don't need to upgrade it now. There are certainly some elements of PSM that could be made prescriptive and standardized throughout the industry.

But this calls back to the difficulty with inspections; OSHA is underfunded and under staffed. The PSM standard requires considerable technical expertise to enforce and there are not enough adequately trained compliance officers to address the PSM covered sites, as is the case with RMP under the EPA.

And then there is the Process Safety Management standard itself; it is written to require certain plans but there is no requirement that these plans be good, only that certain items are addressed. For example, as long as a site has done a Management of Change (MOC) on a replacement other than in kind, they are seen as meeting the standard for compliance or regulatory purposes; there is no requirement to do a beneficial or comprehensive MOC. A simple check-the-box checklist is sufficient. There is no required rigor that has to be built into a MOC.

The USW has been involved with a consortium of groups in California involved in sending comments to Governor Jerry Brown in the aftermath of the Chevron Richmond refinery accident. Even though no one was killed in this event, 15,000 community folks sought medical attention. Nineteen workers who were in the area at the time escaped death or serious injury due to sheer luck.

Our coalition has sent a broad number of proactive steps that can be taken to improve refinery safety and we applaud the state of California for embarking on this journey.

While we have made mention of OSHA and EPA being underfunded and short staffed which hinders their ability to sufficiently do inspections, I want to emphasize that part of following a performance based standard is performing. You can have a great written plan but if you are not following it, it is of little benefit.

Let's go back to Chevron Richmond. The company had a written Mechanical Integrity program that covered inspection of piping. Some engineers raised concerns on a number of occasions that the section of pipe that ultimately failed should have come under more scrutiny. Somewhere along the line a decision was made to not do further inspections or replace the pipe.

We hear that workers have the "Stop Work Authority", that if they identify an unsafe condition, they can have the work stopped until it is safe to continue. That was not the case for our members at Chevron. Workers wanted to take the unit offline but were overruled. While we as workers may have the authority, we certainly do not have the power. This is the fallacy in talking about a safety culture; it is based on a harmonized model. Without the power, the authority means nothing.

While we complain about the lack of regulatory involvement, what about the companies responsibility to act? The same when the leak was discovered; the decision should have been made to depressure and shut the unit down based on material and volume. To maintain the idea that it is safer to operate a unit with a hole in the pipe – which is not going to get better – than to shut a unit down is absurd. If that is the case, you need to take a serious look at your operating procedures and parameters.

Calling this type of operation risk based management is not managing the risk at all. It is just taking a risk.

The core issue is that too often, huge quantities of toxic and/or flammable materials are stored on site posing a needless risk to workers and communities – particularly when reducing quantities or using safer alternatives is possible.

Thank you again for the opportunity to raise some fears workers have about the state of process safety in the petrochemical industry.

REFERENCES

CSB Interim Report, Chevron Richmond Refinery Fire

Beyond Texas City, the State of Process Safety in the Unionized U.S. Oil Refining Industry

A Risk Too Great, Hydrofluoric Acid in U.S. Refineries

Safety Culture and the Issue of Power, Stian Antonsen

Summary Report, Refinery Safety in California, Labor, Community and Fire Agency Views, Michael P. Wilson, PhD, MPH University of California, Berkley

Region 6 Enforcement Division Surveillance Section RMP Inspection Report, 11-05-2012

A RISK TOO GREAT

HYDROFLUORIC ACID IN U.S. REFINERIES

Surveillance video from July 19, 2009, fire and explosion at the CITGO Corpus Christi Refinery

TONY MAZZOCCHI CENTER

New Perspectives CONSULTING GROUP INC

UNITED STEELWORKERS
USW
UNITY AND STRENGTH FOR WORKERS

ACKNOWLEDGEMENTS

In 2010, the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union (USW) initiated the Refinery Alkylation Research Action Project to address the alarming number of fatalities and serious injuries in the U.S. oil refining industry. The project was coordinated through the USW-affiliated Tony Mazzocchi Center for Health, Safety and Environmental Education (TMC). We gratefully acknowledge the contributions of all the local unions who participated, and the members of the Project Team:

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* New Perspectives provides evaluation consulting services for TMC safety and health programs.

Dedicated to Sylvia Kieding

We dedicate this report as a small measure of appreciation for Sylvia Kieding who long served as a union health and safety leader for workers everywhere and especially refinery workers. A long-time supporter and colleague of Tony Mazzocchi, Sylvia was a devoted staff member in health, safety and the environment for the Oil, Chemical and Atomic Workers International Union (OCAW), the Paper, Allied Industrial, Chemical and Energy Workers Union (PACE) and the United Steelworkers (USW) and its Tony Mazzocchi Center for Health, Safety and Environmental Education (TMC) and in cooperation with Queens College, the Worker Health Protection Program (WHPP).

PREFACE: A CULTURE OF RISK

Risk is a natural and unavoidable part of the oil business. As many as four exploratory wells are dry for every well that actually finds oil. Such wells are increasingly expensive, as the hunt for new reserves moves into deeper water and higher latitudes with more extreme weather. A single well can cost hundreds of millions of dollars, and if the well is dry the investment is a total loss. Yet if the risks are great, so too are the rewards. A new field can generate billions in profits. Oil executives are gamblers. They assess, manipulate and ultimately accept huge financial risks every day. The culture of top management is a culture of risk. The oil business rewards risk takers.

But it is one thing to risk money; quite another to risk lives. No industrial process risks more lives from a single accident than does the subject of this report – alkylation using hydrogen fluoride in oil refining. Fifty American refineries use HF alkylation to improve the octane of gasoline. Many are situated in or close to major cities, including Houston, Philadelphia, Salt Lake City and Memphis. In some cases, more than a million residents live in the danger zone of a single refinery. All in all, more than 26 million Americans are at risk.

It is bad enough that such risks exist, especially when much safer processes are available. But are the risks at least being reduced to the absolute minimum through the best possible safety programs? That is the question this report seeks to answer. The study team included safety experts from inside and outside the United Steelworkers as well as refinery workers themselves. Through a standardized questionnaire and data from OSHA, the U.S. Chemical Safety Board, and the industry, they examined the safety of Steelworker-represented refineries using HF alkylation.

The results are shocking. Over a five-year period, the refineries in the study experienced 131 HF releases or near misses and committed hundreds of violations of the OSHA rule regulating highly hazardous operations. Most alarming, for a risk that demands very effective controls, the vast majority of refineries did not reach that level.

Fortunately, HF alkylation can be entirely eliminated. The industry has the technology and expertise. It certainly has the money. It lacks only the will. And if it cannot find the will voluntarily, it must be forced by government action.

This is truly a risk too great.

Leo W. Gerard
International President, United Steelworkers

Gary Beevers
International Vice President, United Steelworkers

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The report is available at:
http://assets.usw.org/resources/hse/pdf/A-Risk-Too-Great.pdf

A NOTE ON NOTES: References are at the end of the report, and are designated by numbers. Footnotes, which further explain the text, are on the same page as text to which they refer, and are designated by letters.

A Risk Too Great

Hydrofluoric Acid in U.S. Refineries

April 2013

EXECUTIVE SUMMARY

Background: Fifty U.S. oil refineries use large volumes of highly concentrated hydrofluoric acid (HF) as chemical catalysts in a process called alkylation. Alkylation creates additives that boost the octane of gasoline. On average, these 50 refineries each store 212,000 pounds of HF.[a]

If released in the atmosphere, HF rapidly forms dense vapor clouds that hover near land and can travel great distances. Like other powerful acids, HF can cause deep severe burns and damage the eyes, skin, nose, throat and respiratory system. But the fluoride ion is also poisonous. Entering the body through a burn or by the lungs, it can cause internal damage throughout the body. At high enough exposures, HF can kill. The Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) regulate HF as *highly toxic*.

EPA requires companies using or storing highly toxic chemicals to gauge how far a worst case release might travel and how many people might be in harm's way. For HF releases from U.S. refineries, the range is three to 25 miles, depending mostly on the amount stored. Twenty-six million people live within the vulnerable zone, many in urban areas like Philadelphia, Memphis, Salt Lake City, and the Houston – Galveston corridor that would be impossible to evacuate quickly in the event of a major release. No other chemical operation puts as many people at risk.

The Survey: How well are refineries managing the risk of an HF release? To answer this question, a research team from the United Steelworkers, the Tony Mazzocchi Center and the New Perspectives Consulting Group developed a 198 question survey that focused on four key issues: incident prevention; incident and near miss experiences; incident mitigation systems, and emergency preparedness and response. Though not directly addressed in the survey, a fifth issue included in this report is safe staffing.

Workers in 28 of the 50 refineries using HF alkylation are represented by the United Steelworkers. Local unions in 23 of those refineries formed site survey teams and completed the survey, for a response rate of 82 percent. Combined, the 23 study refineries produce 3.3 million barrels of finished petroleum products per day and have over 5.3 million pounds of HF on site. These 23 refineries put approximately 12,000 workers and 13 million community members at risk of exposure from an HF release.

What the survey found:

- Within a recent five-year span, study refineries had 293 violations of OSHA's Process Safety Management (PSM) Standard regulating highly hazardous chemical operations.[b]
- Over three-quarters of the site survey teams reported at least one HF-related incident or near miss in the previous three years. These totaled 131 HF-related incidents or near

[a] Data gathered at U.S. EPA Headquarters by staff from the Center for Public Integrity in October 2010.
[b] This does not include the BP refinery in Texas City that received intense OSHA scrutiny following major catastrophic accidents including the 2005 disaster that killed 15 workers. That site had 593 violations. Texas City is also the refinery that stores the largest amount of HF.

misses. Among 16 sites reporting their most serious or potentially serious HF-related events, all reported the events either *did* or *could have* caused injuries to workers on-site, and half indicated that these events could have caused injuries to people in the community.

- A chemical as lethal as HF demands the most effective safety systems. Yet more than half of the site survey teams reported that 26 out of 32 safety systems were *less than very effective* in three critical areas -- maintaining the integrity of HF alkylation processes, maintaining the integrity of related processes such as storage and transfer, and emergency mitigation. For the remaining six systems examined, a majority rated them as *very effective.*
- Almost two-thirds reported their sites were *less than very prepared* with emergency personal protective equipment for on-site workers who might need it during a release.
- Site survey teams rated preparedness for HF-related emergencies for four groups of workers: on-site emergency responders; off-site emergency responders; on-site nursing and medical personnel, and first receivers (e.g., hospital workers). More than half of the sites rated each worker group *less than very prepared* for an on-site emergency. Sites were assessed to be even less prepared for a larger release spreading into the surrounding community.
- Although the survey did not include questions on staffing, a number of site survey teams commented that staffing levels were too low to ensure the safe operation of alkylation units.

Alternatives to HF: There are other ways to perform alkylation in an oil refinery. Some refineries use a modified form of HF containing a chemical which renders it less volatile. Others use sulfuric acid instead of HF. Both methods have their drawbacks, and both are hazardous, although not as hazardous as alkylation using unmodified HF. Far safer alternatives exist for catalyzing alkylation reactions. They use either solid catalysts or liquid ionic catalysts. Both these safer alkylation catalysts have been demonstrated successful at the pilot stage, and, for liquid ionic, in production. Releases of either of these alternative catalysts would be relatively benign, especially in comparison to HF. Still, no U.S. refinery has yet converted to these alternatives.

Conclusions: There must be fundamental change in the oil industry's use of HF. The long-term solution is to replace HF alkylation with safer systems not requiring the use of so toxic a chemical. In the meantime, existing alkylation units can and must be made safer.

In particular, the industry should:

1. Commit to ending the use of HF alkylation and replacing it with safer alternatives as soon as possible.
2. Develop, build and test pilot alkylation units using safer chemicals and processes, sharing lessons from those operations to speed the transition to full-scale safer alternative alkylation processes across the industry.

3. Work cooperatively with unions and other stakeholders to educate site workers, on- and off-site emergency responders and receivers, and the public about the dangers of HF.
4. Make existing HF alkylation processes systems safer by improving process integrity, mitigation systems, and emergency response, and by converting to the use of modified-HF.
5. Create an open and transparent system for reporting HF-related releases, near misses and process upsets, both within and outside the corporation, so that similar events can be avoided.
6. Work with the USW and other unions to promote effective process safety programs based on rigorous hazard identification and correction.
7. Increase staffing to a level that will be effective in preventing, preparing for, and responding to potential HF alkylation unit emergencies.

The government can facilitate this process through intensive inspections of HF alkylation units under OSHA's Process Safety Standard and the EPA Risk Management Program. HF alkylation as it is currently performed in U.S. refineries is a risk too great, but that risk can be reduced and ultimately eliminated.

A Risk Too Great

Hydrofluoric Acid in U.S. Refineries

INTRODUCTION AND BACKGROUND

Thousands of workers, millions of community members and vast stretches of air, land and water are at risk from oil companies' use of hydrofluoric acid (HF) at 50 U.S. refineries. In several cases, a single HF-using refinery puts hundreds of workers and more than one million community members at risk of devastating injuries and even death. This is a risk too great.

Where It All Begins

Clean-burning gasoline requires a high octane rating. Oil refineries achieve these ratings using additives produced in processes called *alkylation*. These alkylation processes work by using acid catalysts to modify petroleum feed materials to form what are called *alkylates*. Refineries blend these alkylates with other refining products to create gasoline for retail sale.

Alkylation: Extremely Hazardous Chemical Processes

Currently, U.S. refineries use two different processes and chemical catalysts for alkylation. One involves very large volumes of highly concentrated sulfuric acid (H_2SO_4). The other, the subject of this report, uses very large volumes of highly concentrated hydrofluoric acid (HF). Sulfuric acid alkylation processes are hazardous, but not as hazardous as HF alkylation. HF is much more dangerous when released because it readily forms dense, highly toxic vapor clouds that hover near land and can travel great distances. In contrast, sulfuric acid typically remains in a liquid state during upsets and releases.[a] And while both acids are highly corrosive, HF is also a systemic poison. Importantly, there are now alkylation catalysts and processes that are much safer than either sulfuric acid or HF. This report will address these innovations in later sections.

[a] HF has a boiling point of 67 °F and a vapor pressure of 783 mmHg. By comparison, sulfuric acid has a boiling point of 554 °F and a vapor pressure of 0.01 mmHg.

HF – Extremely Toxic

HF is a fast-acting acid and can cause deep, severe burns. Exposure can occur through inhalation and skin contact. HF can permanently damage the eyes, skin, nose, throat, respiratory system and bones. The fluoride ion can enter the body when HF is inhaled or through a skin burn, where it can interfere with calcium metabolism and cause death by cardiac arrest. (See Appendix A: HF Hazards)

Both the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) regulate HF as *highly toxic*. The quantities of HF stored in the 50 U.S. refineries that use it for alkylation ranges from 5,200 to 870,000 pounds. The average per refinery is 212,000 pounds; the median, 150,000 pounds.[1]

Of special importance to these refineries is the concept of *process safety*. Process safety is the art and science of preventing fires, explosions and major releases of dangerous chemicals from tanks, vessels and piping where they are used or stored. OSHA covers these refineries under its *Process Safety Management of Highly Hazardous Chemicals* (PSM) standard. This standard is designed to protect *workers* from catastrophic releases and exposures. EPA covers these same refineries under its *Risk Management Program* (RMP) rule. EPA's rule is designed to protect *communities* by preventing releases and preparing for emergency responses.

Nevada Test Sites Studies

Scientific tests of HF releases conducted in 1986 in the Nevada desert surprised researchers when 100 percent of the released liquid HF formed dense, rolling clouds of toxic vapor (see sequence of photos in Figure 1). The clouds expanded rapidly and researchers measured dangerous concentrations at distances of three to six miles downwind. The tests showed that unless a refinery HF release is effectively mitigated it could place large numbers of refinery workers and large swaths of the surrounding communities in terrible danger.[2,3]

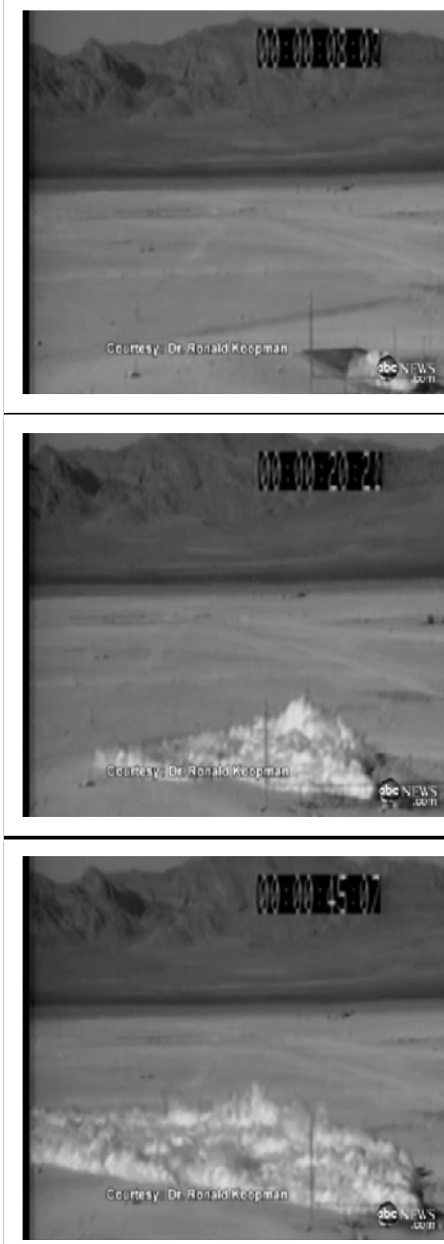

Figure 1. August 1986, an industry-sponsored controlled release of anhydrous hydrofluoric acid at a remote area of the Nevada Test Site. The seven minute test release created a hydrofluoric acid cloud over 10 feet high and visible from as far as ¾ of a mile.

Guidelines, Mitigation and Modifications Not Enough

The American Petroleum Institute (API), an organization of petroleum companies, has a recommended practice titled Safe Operation of Hydrofluoric Acid Alkylation Units (RP 751).[4][a] The guidelines are useful – if followed. But like all API-recommended practices they are voluntary, although OSHA can sometimes use them to establish a violation of the PSM Standard. In addition, the guidelines were developed without the adequate involvement of key stakeholders such as refinery workers, labor unions or community residents and organizations.

The industry has tested and promoted mitigation systems to lessen the impacts of HF releases. These include water cannons, sprays and rapid systems for transferring HF from a compromised vessel. These systems would help contain a release, but they could fail or be overwhelmed in an emergency. (See Appendix A: HF Process Controls and Modifications.)

A small but growing percentage of HF-using refineries use *modified* HF. Modified HF has chemical additives such as sulfolane[b] that are intended to reduce the rate of HF vaporization. Theoretically, modification also reduces the distance that an HF plume would travel. However, modification of HF does not keep it from vaporizing and creating a traveling plume, nor does it reduce the toxicity of HF.[c] If the release was accompanied by a fire – and many refinery accidents involve fires – the vaporization of even modified HF would be greatly increased.

Lessons from the History of Chemical Disasters

A characteristic of previous major chemical disasters is that they occurred as the result of failures of multiple safety systems. Further, these disasters typically propagated and cascaded in ways that were not fully anticipated and were beyond the capacities of mitigation and emergency response systems. The Deep Water Horizon disaster that began April 20, 2010, in the Gulf of Mexico is a prime example. It immediately killed 11 workers, ignited a fire visible for dozens of miles, and sank a giant oil platform. BP and its contractors tried to activate the main control device, a blowout preventer, but it failed. It remained in a failed state and the disaster continued to unfold until the leak was stopped 86 days later. The disaster showed that the oil industry's prevention and response plans were completely inadequate.

The report of the National Commission on the BP/Deepwater Horizon Oil Spill and Offshore Drilling[5] repeated the finding made by the Columbia (Space Shuttle) Accident Investigation Board[6] in 2003 that "complex systems almost always fail in complex ways." (p. viii and p. 6 respectively) Further, the Deepwater Horizon Commission report stated, "An unfortunate lesson of the oil spill is that the nation was not well prepared for the possibility of widespread, adverse effects on human health and mental well-being, especially among a particularly vulnerable citizenry" (pp. 191-192).

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[a] The Recommended Practice addresses hazards management, operating procedures and worker protection, new construction, inspection and maintenance, transportation and inventory control, relief and utility systems, and mitigation options and techniques.

[b] Chemical name: tetrahydrothiophene 1,1-dioxide: boiling point 545 ^{o}F; 0.026 mmHg. The boiling point of modified HF (i.e., the mixture) has not been determined.

[c] The "Potential Health Hazards" sections of HF manufacturer Honeywell's Material Safety Data Sheets for a) Hydrofluoric Acid, Anhydrous and b) Modified Hydrofluoric acid are identical as are the "Emergency Overviews."
http://www51.honeywell.com/sm/hfacid/common/documents/AHF_MSDS.pdf; (Last accessed March 12, 2013)
http://www51.honeywell.com/sm/hfacid/common/documents/Modified-HF.pdf. (Last accessed March 12, 2013)

U.S. Workers, Communities and the Environment at Risk

Twenty-five oil companies use HF at 50 U.S. refineries. Collectively, these refineries put more than 26 million persons at risk from an HF release. Among these are 19 refineries in or near eight major metropolitan areas that put more than 22 million persons at risk. The USW represents approximately 7,000 workers at 28 of these refineries.

(See Appendix C: Table C1 and C2.)

The EPA, through its RMP rule, requires companies with greater than threshold quantities of specific chemicals to estimate of the size of the population at risk from a release. These estimates are made by drawing a circle on a map with the potential release point at the center. The population within the circle defined by a radius of the *endpoint distance* is that which is vulnerable in the event of a worst case HF release. The size of the circle depends on the amount of chemical, in this case HF, that would be released and how far it might travel in a "worst case" scenario as defined by EPA. Among the HF-using refineries in the United States, the median *endpoint distance*[a] for HF toxic worst case release is 15 miles (range of 3 mi. to 25 mi. for the 50 refineries). Forty-two of these refineries have an endpoint distance of greater than 10 miles with nearly half of those having an endpoint distance of greater than 20 miles.[b]

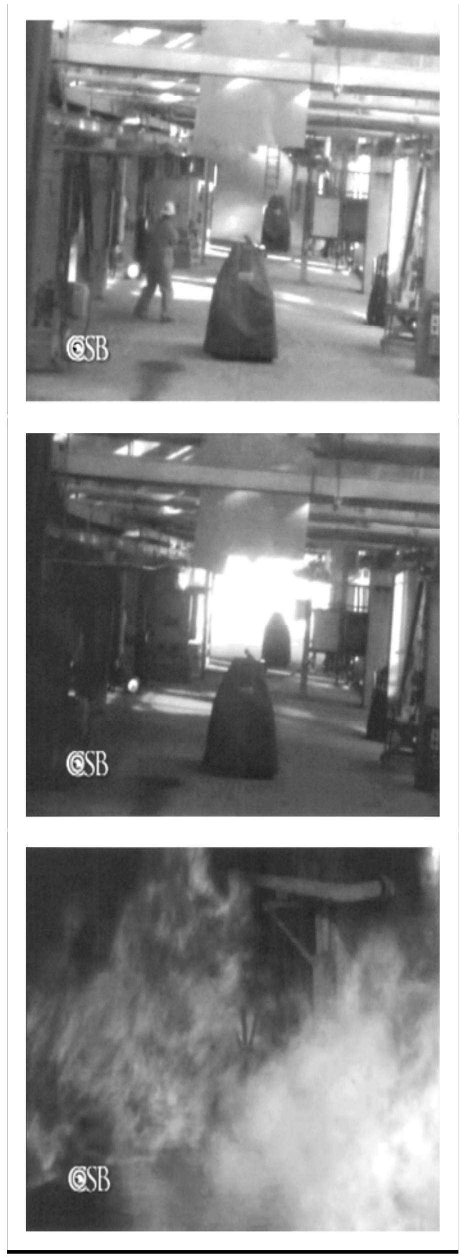


Figure 2. July 2009 hydrofluoric acid fire, explosion and release at the CITGO Corpus Christi Refinery.

A Horrifying Scenario

Following 9/11, in his book The Edge of Disaster: Rebuilding a Resilient Nation, Stephen Flynn argued, "Our top national priority must be to ensure that our society and our infrastructure are resilient enough not to break under the strain of natural disasters or terrorist attacks"[7][c] (p. 110). In an article taken from his book, Flynn develops a disaster scenario at an HF-using refinery in a major metropolitan area. He describes events following an "entirely plausible" fictional attack on the refinery's HF tanks and a major release:

"Thousands of people are trapped in their cars as the

[a] The distance beyond which specified harmful effects would no longer be felt.
[b] Fourteen of the refineries have an endpoint distance of 25 miles, the maximum of EPA's lookup tables and RMP*Comp software.
[c] Stephen Flynn, Ph.D. is a retired officer from the U.S. Coast Guard and an expert on homeland-security. He is now Professor in the Department of Political Science at Northeastern University and Founding Co-Director, George J. Kostas Research Institute for Homeland Security.

hydrofluoric cloud drifts over them, burning their eyes and eyelids. Soon, their lungs become inflamed and congested, depriving them of oxygen and leading to seizures. Most die within ten hours."[8]

Variations of this scenario might be applicable at any one of the 50 HF-using refineries in the United States.

In addition to the resiliency Flynn calls for, the nation's refining infrastructure also needs to be resilient enough not to break under the strain of unplanned and unintended systems failures during the course of normal operations, startups and shut downs. These are far more common than natural disasters and terrorist attacks.

The Record

Catastrophic Chemical Accidents and Process Safety Systems

The underlying or root causes of most chemical process accidents are deficiencies in the management of process safety systems. Management of these safety systems is the foundation for OSHA's PSM standard, the U.S. EPA's RMP rule, and internationally, the European Union's Seveso II Directive. Nonetheless, according to former U.S. Chemical Safety Board member Dr. Irv Rosenthal and others, writing in the journal *Process Safety Progress*, these requirements have been insufficient to stem the tide of accidents.[9] These risk experts stated, "the less than expected decrease in accident incidence has occurred because the newly adopted regulations have not resulted in the hoped for adoption of 'effective' process safety management systems by industry" (p. 136).

Refinery Disasters – Infrequent But Not Rare

The infrequency of major catastrophic accidents in the refining industry can foster the belief that the probability of these events is so low that "it can't happen." This has given rise to labeling these types of accidents *low probability–high consequence* (LP–HC). Having done extensive research in this arena, the EPA's James C. Belke stated:

> "From the perspective of the individual facility manager, catastrophic events are so rare that they may appear to be essentially impossible, and the circumstances and causes of an accident at a distant facility in a different industry sector may seem irrelevant"[10] (p. 7).

Thus, while the cumulative risk from dozens of refineries is substantially higher, there is a potential for complacency or overconfidence of management at individual refineries.

In 2000, Belke authored an EPA study using RMP incident data from 1994 to1999.[11] That study documented that oil refineries had nearly twice as many accidents as any other RMP industry. One hundred and one of these were HF incidents. That study also revealed HF ranked third among regulated chemicals in the number of process release incidents.

Industry Reports on Safety – No Assurance

An extensive study of process safety incidents by Michael R. Elliot and others[12] sheds additional light on refinery safety. The study found that there are no strong positive correlations between LP–HC incidents and regularly reported occupation illness and injuries (OII) or OII rates. Nonetheless, the refining industry commonly reports on these data as evidence of refinery safety. In May 2010, Deputy Assistant Secretary for Federal OSHA, Jordan Barab, addressed this and other issues in a speech before the National Safety Conference of the National Petroleum Refiners Association (NPRA).[13] He told the industry, "Stop boasting about your safety record [referring to OII rates] when you're literally putting out fires. You're only undermining your credibility."

Barab also spoke in broad terms about the energy industry's record on major accidents:

> "OSHA is particularly concerned about the recent number of serious incidents at refineries that have scalded, burned or struck down your fellow workers. We are tracking these catastrophes and looking for trends -- including problems resulting from aging facilities."

In 2007, OSHA instituted a National Emphasis Program (NEP) to "reduce or eliminate workplace hazards associated with the catastrophic release of highly hazardous chemicals at petroleum refineries."[14] This greatly increased the number of OSHA inspections at refineries that were focused on process safety and its PSM standard. Nonetheless, three years later, OSHA's Barab was moved to express that he was, "deeply troubled by the significant lack of compliance we are finding in our inspections and with the number of serious refinery problems that continue to occur."[13]

In April 2011, Dr. Rafael Moure-Eraso, Chairperson of U.S. Chemical Safety Board (CSB) used the one-year anniversary of the 2010 Tesoro refinery disaster in Anacortes, Wash., to assess the status of the U.S. refining industry. He said, "Serious incidents at refineries continue to occur with alarming frequency."[15] The trail of U.S. refinery disasters and non-compliance with regulations is a potent reminder of the potential for catastrophe. (See Appendix A: Major Oil Industry Incidents, and HF Alkylation Unit Incidents.)

USW Study Confirms Industry Unprepared to Prevent or Respond to Refinery Incidents

Following the 2005 BP Texas City Refinery disaster, the USW conducted a nationwide study titled, Beyond Texas City: The State of Process Safety In The Unionized U.S. Oil Refining Industry.[16] This study examined the extent of highly hazardous conditions like those that contributed to the Texas City disaster at 51 unionized refineries. The study found that these highly hazardous conditions continued to be pervasive. Further, it found that these conditions had often resulted in incidents or near misses. Training was found to be insufficient and less than a third said their refineries were reported to be *very prepared* to respond safely to hazardous materials emergencies. The study concluded that the refining industry is ripe for future disasters.

Doing More with Less? Understaffing Is Unsafe

Examination of the BP Texas City Disaster Looks at Refinery Staffing

The 2005 BP Texas City disaster surfaced the critically interconnected issues of refinery understaffing and process safety. The Baker Panel, proposed by the CSB and headed by former White House Chief of Staff, James Baker, studied process safety management at five U.S. BP refineries. The Baker Panel study found that understaffing was a serious safety problem, common for routine operations, and existed for upset conditions and emergencies. Understaffing was identified among maintenance personnel, operators, chief operators and supervisors and was recognized by both hourly workers and management. The study noted that this understaffing resulted in unsafe performance of jobs at the refineries. Understaffing was also linked to inexperienced supervisors, low morale, poor communication, delayed responses to needs, inability to supervise contractors properly, interference with training, and slowed hazard assessments and investigations.[17]

While there are no regulations in the United States for governing staffing levels at refineries, the nuclear industry, one with similar disaster potential to refineries with large quantities of HF, provides some guidance. The U.S. Nuclear Regulatory Commission (NRC) in its *Guidance for Staffing Exemption Requests* provides prescriptive regulations for qualifications and staffing levels (e.g., enumerating specific staffing requirements for senior operators and operators for a given number of operating units).[18,a] In addition, the NRC recognizes that these prescriptions may not be adequate to address certain design features and operations. As a result, the NRC has more detailed regulations in its *Guidance* that requires a task analysis of "risk-significant human actions; difficult tasks identified through the operating experience review; a range of procedure-guided tasks that are well defined by normal, abnormal, emergency, alarm response, and test procedures" and knowledge-based tasks, human decision-making and interactions, and frequent and infrequent tasks (p. II 3-2).

Circadian, a global leader in providing guidance on 24/7 workplace performance and safety solutions, recently published a white paper on safe staffing levels. In that report Circadian stated, "Understaffing is a major contributor to not only fatigue and human error, but also to the health, safety, performance and quality of life" of employees[19] (p. 15). Accordingly, based on extensive field study, they posited that an overall overtime rate of 20 percent is "arguably unsafe to operate because of the significantly increased risk of human error. This is particularly true with night shifts, rotating schedules and/or long, irregular hours." (p. 13)

The United Kingdom's Health and Safety Executive (the counterpart to U.S. OSHA) provides further guidance. It established its Staffing Levels and Task Organization Technical Assistance Guide (TAG 061) in part on deficiencies in staffing and task organization identified at Three Mile Island, Chernobyl, BP Texas City and the Challenger Space Shuttle.[20] TAG 061 addresses staffing and task organization of licensed nuclear facilities in accordance with the requirements of the International Atomic Energy Agency (IAEA) Requirements and Guides. (See Appendix A: Technical Assessment Guide (TAG) 061: Staffing Levels and Task Organisation.)

Recently, the oil industry attempted to address staffing through the 2010 American Petroleum Institute Recommended Practice 755, "Fatigue Risk Management System," developed pursuant to a recommendation from the U.S. Chemical Safety and Hazard Investigation Board. Although the CSB requested that the USW and API work together on the issue, and the API promised a "consensus" process, in the end the API insisted on a process through which the union was consistently outvoted on important issues. The union eventually left the discussions in frustration. Although better than nothing, RP 755 is a weak standard, with numerous loopholes and provisions open to interpretation. Like all API Recommended Practices, it is voluntary. So far, it has had little impact on staffing levels.

[a] Minimum Requirements Per Shift for On-Site Staffing of Nuclear Power Units by Operators and Senior Operators Licensed Under 10 CFR Part 55 (with allowance for temporary deviations).

Safer Alternatives

Chemists and engineers have come up with a number of ways to make hazardous chemical operations not just safer, but safer at their core. These approaches are called *inherently safer technologies* (IST). First and foremost among these is replacing the dangerous chemicals or processes in use with ones that are safer. Substitution of a less dangerous chemical for a highly toxic one is a long-held, widely accepted best practice in occupational and environmental health. It is also one promoted by the American Institute of Chemical Engineers (AIChE), and its Center for Chemical Process Safety. AIChE, a largely industry-based professional group, has published and promoted the concept of inherently safer design in chemical process industries like oil refining.[21, 22] Fortunately, inherently safer technologies exist for alkylation.

An *ionic liquid alkylation* process has been successfully developed, piloted and put into production. This method is inherently safer than HF alkylation processes. It is also safer than sulfuric alkylation processes. Using ionic liquid alkylation, Chinese refiners[23] have successfully produced alkylates in both pilot and production phases. These alkylates are reported to compare favorably with those produced by HF and sulfuric acid processes. In contrast to alkylates produced with HF and sulfuric acid, these alkylates are produced without the dangers to workers, communities and the environment posed by current processes.[24] With ionic liquid alkylation, the large volumes of HF and sulfuric acid would be gone. Also removed would be the risks they pose to the environment, tens of thousands of workers and millions of community members surrounding refineries.

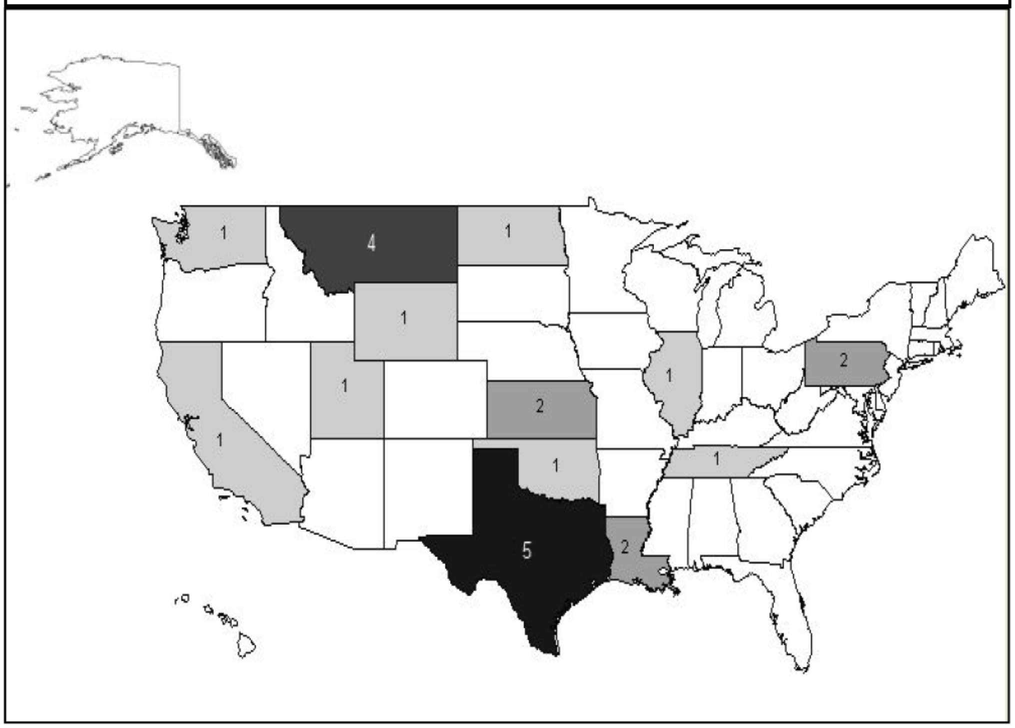
Solid acid catalyst (SAC) alkylation systems are another alternative to HF and sulfuric acid alkylation. In 2004, a consortium of companies announced that they had one and a half years of documented operating performance using a solid acid catalyst (SAC) system. This system also eliminates the use of large quantities of HF and sulfuric acid.

Some have suggested sulfuric acid processes, already widely used in dozens of U.S. refineries, should be considered as a safer alternative to HF alkylation. While sulfuric acid is much safer than HF, it still poses substantial hazards for workers, community members and the environment. (For more see an additional USW report the Sulfuric Acid Alkylation to be released later in 2013.)

THE USW SURVEY

In late 2010, a survey questionnaire was developed by a team of refinery workers, health and safety specialists, and professional survey researchers. The questionnaire was sent to 61 USW refinery local unions with alkylation processes using either hydrofluoric acid (HF) or sulfuric acid in the United States. Twenty-eight of these refineries used HF. Among these, 23 site survey teams returned questionnaires for a response rate of 82 percent. This report is about findings from these 23 refineries. (Findings for the refineries using sulfuric acid for alkylation will be presented in a companion report.) Figure 3 shows the states where the 23 responding HF refineries were located.

Figure 3. Number of Responding U.S. Refinery Sites Using HF in Alkylation (n = 23)



The 198-item questionnaire addressed the safe operation HF alkylation units, and the procedures in place to prevent and mitigate releases. Researchers requested that each responding local union create a multi-disciplinary site survey team made up of local union members in six specific roles. These roles included: 1) local union leadership, 2) those with specific health and safety responsibilities, 3) alkylation unit operators, 4) maintenance workers, 5) those on process hazard analysis (PHA) teams, and 6) emergency responders. The range of members participating on each of these 23 site survey teams ranged from 63 percent of those who had served on PHA teams, to 95 percent each for those who were local union leadership or operators, and 100 percent for those with specific health and safety responsibilities. (See Appendix B: Table B1.)

The Study Refineries

Production

Combined, the 23 study refineries with HF alkylation units produced 3.3 million barrels of finished petroleum products per day with an average production of 145,000 barrels per day per refinery.

Quantities of HF

The 23 refineries in this study collectively had over 5 million pounds of HF on site. The quantities of HF per refinery ranged from 5,200 pounds to 870,000 pounds with an average of 233,000 pounds.[a] These data were gathered from refining company reports to EPA as part of its Risk Management Program (RMP) rule. Refineries covered under EPA's RMP are required to implement chemical accident prevention and preparedness measures, and to submit summary reports to the government when quantities of listed highly hazardous chemicals, in this case HF, exceed the regulatory threshold. These reports contain information about the quantities of chemicals on site as well as the potential consequences of accident release scenarios.

Additional information is available from OSHA inspection data that identified violations of its Process Safety Management (PSM) Standard (29 CFR 1910.119). The standard is the counterpart to EPA's RMP regulation; it regulates key process safety systems to prevent workers from being injured or made ill at sites with very large quantities of highly hazardous substances.

Potentially Affected Populations

The potentially affected populations for possible worst case releases of HF in the communities surrounding the 23 study refineries range from 20,000 persons to over 3 million persons. In total, over 13 million community members are potentially at risk of exposure to highly toxic HF from the 23 refineries studied.[l]

OSHA Violations Found During OSHA Process Safety Management Inspections at Study Refineries

Among the 23 study refineries with HF alkylation units, 21 had OSHA PSM violations within the five years previous to February 2011. [b] Among 20 study refineries, there were 293 violations – an average of 21 per refinery, and a range of from 1 to 35 violations. This does not include the BP refinery in Texas City that received intense OSHA scrutiny following major catastrophic accidents including the 2005 disaster. That site, an outlier in terms of data from other refineries, had 593 violations.

Profits Among Companies Operating Study Refineries

One potential obstacle to finding and correcting process safety vulnerabilities or in replacing existing systems and chemicals with safer ones is financial resources. Accordingly, the 2010 gross operating profits for the publicly held corporations operating 18 of the study refineries

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[a] Data gathered at U.S. EPA Headquarters by staff from the Center for Public Integrity in October 2010.

[b] Data extracted from the OSHA's IMIS Database by the staff of the Center for Public Integrity, February, 2011. (http://www.osha.gov/pls/imis/establishment.html). PSM violations are rom all inspections during the previous five years including, but not limited to OSHA National Emphasis Program (NEP) inspections.

were obtained. These 18 refineries were operated by eight oil companies. In total, these eight companies had gross operating profits in 2011 of approximately $150 billion.[a]

[a] Data from Market Watch. http://www.marketwatch.com

SURVEY FINDINGS

1. How the Results Are Reported

A major release of HF from a refinery would be catastrophic. Systems whose failures could result in catastrophe demand the highest level of safety. Few airline passengers or government regulators would tolerate airline safety systems that were judged to be *somewhat effective* rather than *very effective.* Likewise, workers, community residents and the natural environment deserve safety systems for refinery processes that are *very effective*. This is especially so when it comes to preventing and responding to potential releases of highly hazardous chemicals like HF. Many of the questions in this survey asked whether refinery safety systems were *very effective*, *somewhat effective*, *somewhat ineffective*, or *very ineffective*. In these cases, *very effective* was the standard we used in this report. Therefore, this report compared safety systems that were judged *very effective* with all those judged to be of lower effectiveness. When making these comparisons we use the phrase "*less than very effective.*" We also use this standard when we assess other measures such as *confidence* and *preparedness*.

2. HF Alkylation Process Safety Systems: Preparedness to Prevent Disaster

The safety of process operations at refineries is governed by what are known as process safety systems. These systems must be in place to operate safely in normal and abnormal conditions and must be able to quickly and effectively mitigate process upsets, leaks, fires and other emergency conditions. The safety of alkylation units depends on the effectiveness of individual component systems within the process unit and their functioning as interdependent parts of an integrated whole. With very large quantities of highly hazardous materials, these systems need to operate at peak performance. The 23 site survey response teams rated 32 process safety systems related to HF alkylation units. These assessments of HF alkylation safety systems are presented in three groups. The first two groups of process safety systems are aimed at prevention:

A. Effectiveness of safety systems for maintaining the integrity of *HF alkylation processes* (nine systems)

B. Effectiveness of safety systems for *HF-related processes, storage, and transfer systems*, *taken as a whole* (11 systems)

These two groups will be discussed in this section. The third group was:

C. Effectiveness of HF emergency mitigation and response systems (12 systems)

This group will be discussed in the later section — *Prepared to Respond*.

A. Effectiveness of Safety Systems for Maintaining the Integrity of HF Alkylation Processes

Site survey teams rated the nine systems for maintaining the integrity of *HF alkylation processing* as follows:

- For five systems ranked least effective – sewer systems, mechanical integrity of piping, mechanical integrity of pumps valves, seals and vents; maintenance; and integrity of instrumentation – 65 percent to 79 percent of site survey teams rated them as less than *very effective* (22 percent to 35 percent *very effective*). From 26 percent to 44 percent of sites rated them as *ineffective*.

- For three process systems – corrosion monitoring, mechanical integrity of pressurized tanks and vessels, and inspection and testing – approximately half (from 52 percent to 56 percent) site survey teams rated them as less than *very effective* (39 percent to 48 percent *very effective*). From 4 percent to 13 percent of sites rated them as *ineffective*.
- For the only system that fewer than half of the site survey teams rated less than *very effective* was – mechanical integrity of atmospheric tanks – 44 percent rated this system less than *very effective* (56 percent *very effective*). Six percent (6 percent) rated this system *ineffective*.

(See Appendix B: Table B2.)

B. Effectiveness of Safety Systems for HF-Related Processes, Storage, and Transfer Systems, Taken as a Whole

Site survey teams provided overall ratings for a group of 11 safety systems that focused on process, storage, and transfer systems related to HF alkylation. These ratings follow:

- For three systems ranked least effective – audit programs, maintenance, and health hazard information and education for site personnel *outside* of HF alkylation units – 78 percent to 82 percent of site survey teams rated them as less than *very effective* (9 percent to 22 percent *very effective*). From 26 percent to 39 percent were rated *ineffective*.
- For six more highly ranked systems – operating manuals and procedures; utility systems; HF unit pre-start-up safety reviews; process hazard analyses (PHAs); leak detection and repair, and strictly controlled access to HF alkylation units key to preventing HF incidents – 57 percent to 69 percent of site survey teams rated them less than *very effective* (26 percent to 43 percent *very effective*). From 9 percent to 35 percent rated them *ineffective*.[a]
- For only two of the safety systems – health hazard information and education for personnel *within* HF alkylation units, and controlled relief and neutralization systems – less than half of the site survey teams (35 percent and 44 percent respectively) rated them as less than *very effective* (65 percent to 52 percent *very effective* respectively).

(See Appendix B: Table B3.)

3. HF Alkylation Unit Incidents and Near Misses

One way to assess the safety of alkylation units is to examine HF-related incident and near miss histories of these processes. The following summarizes site survey team reports of HF-related incidents and near misses.

- Over three-quarters of site survey teams (18 sites or 78 percent) reported at least one HF-related incident or near miss in the previous three years. Five sites (22 percent) reported that they had no HF-related incidents or near misses.

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[a] For one system, controlled access, 4% said they do not have this. We included this 4% in both "less than *very effective*" and the "*ineffective*" groupings.

- The 18 sites with HF-related events reported a total of 131 incidents or near misses – 115 events related to HF alkylation processing and 16 events related to HF storage or transfer. This was an average of 7.3 events per site over the three year period, or 2.4 HF-related events per site per year.

Site survey teams provided further details about the most important HF incident or near miss (usually the one that was most serious or potentially serious). Of the 18 sites with events, 89 percent (16 sites) reported incidents as most important and the other two sites reported near misses as most important. Nearly all (17 sites or 94 percent) reported that these events involved alkylation process unit events while 17 percent (3 sites) also involved on-site HF storage, and 11 percent involved both off-loading and on-site transfer of HF (2 sites). Among these events, 83 percent involved spills or releases (15 events) and 17 percent involved fires or explosions (3 events). Site survey teams all reported the events either *did* or *could have* caused injuries to workers on-site. Half (9 sites) indicated that these events could have caused injuries to people in the community. While none reported fatalities related to these events, the number of injuries reported ranged from none to 13. In total, 24 workers were injured. Twenty-two (22) of the injured received first aid and 16 received treatment in emergency rooms. Six were admitted to hospitals for their injuries.

4. Prepared to Respond

A. Effectiveness of HF Emergency Mitigation and Response Systems

A similar picture of deficiency emerged when examining the third set of process safety systems that focused on HF emergency mitigation and response related to potential HF releases. The ratings for these 12 systems follow:

- For the five systems ranked least effective – off-site alarms and notification systems; utility back-up systems; emergency field drills; safe havens for employees needing refuge from HF releases, and diking systems to contain spills – 74 percent to 86 percent rated them less than *very effective* (9 percent to 22 percent *very effective*). From 39 percent to 48 percent rated them *ineffective* or *don't have*.[a]
- For four additional mitigation and response systems – chemical neutralization systems; fire suppression systems; remotely operated block valves for isolating HF units, and water curtain and deluge systems – 56 percent to 69 percent of site survey teams rated them less than *very effective* (32 percent to 43 percent *very effective*). From 8 percent to 28 percent rated them *ineffective* or *don't have*.[b]
- For only three systems – overall emergency shutdown and isolation systems, on-site alarms, and emergency rapid transfer systems for HF – less than half (40 percent to 43 percent) rated them less than *very effective* (52 percent to 57 percent *very effective*).

(See Appendix B: Table B4.)

[a] These include 35 percent *don't have* for off-site alarms, 22 percent for safe havens, 17 percent for utility back-up, and 13 percent for both emergency field drills and for diking. *Don't have* responses are included in *ineffective* and less than *very effective* ratings.
[b] These include 23 percent *don't have* for chemical neutralization systems, 9 percent *don't have* for fire suppression systems, 4 percent *don't have* for overall emergency shutdown and isolation systems. *Don't have* responses are included in *ineffective* and less than *very effective* ratings.

An HF release might come about as a result of a fire or explosion. Refinery water supplies need to be sufficient to simultaneously generate fire-fighting foam, cool overheating vessels and piping, (possibly in multiple units) and to operate HF water mitigation systems to suppress HF vapors.

- When asked about adequacy of water supplies for both these purposes, 30 percent reported that their sites *did not have* adequate supplies and 17 percent said *don't know*. A slight majority, 52 percent reported that their sites had adequate water supplies**.**

B. Emergency Responder Preparedness

Should HF containment systems fail, employees at the site must rapidly perform safe and orderly shutdown, mitigation and evacuation. Accordingly, the survey asked about necessary personal protective equipment (PPE) for every employee who might need it in an HF emergency. Approximately two-thirds of site survey teams (65 percent) reported their sites were less than *very prepared* with PPE (35 percent *very prepared*). More than one in three sites (39 percent) reported that the refinery was *unprepared* with PPE.

(See Appendix B: Table B5.)

The survey also assessed overall preparedness of four key groups of workers that would need to respond if there was an HF release at a refinery:

a) The refinery's on-site emergency responders
b) Local community's off-site emergency responders
c) On-site nursing and other medical personnel
d) Local hospitals (or first receivers)

Furthermore, the survey examined this preparedness for three different levels of possible refinery HF releases:

- Releases limited to a work area where fewer than 10 workers may be seriously exposed
- Releases that spread across the whole refinery where dozens of workers may be seriously exposed
- Releases that extend outside the refinery where community members may be seriously exposed

In combination, these four worker groups and these three distinct levels of potential HF releases constituted 12 categories of preparedness. These ratings have added importance when considering that 78 percent of the study refineries reported 131 HF-related incidents or near misses in the previous 36 months. Further, half the site survey teams that reported on their sites' most important incident said the events could have caused injuries to people in the community.

(See Appendix B: Table B6 for the data described below.) [a]

[a] In reporting of data for each of the work groups, the *don't have* responses are included in the categories of less than *very prepared* and *unprepared*.

a) Refinery's on-site emergency responders

- For **HF releases limited to a work area**, 57 percent reported that on-site emergency responders were <u>less than</u> *very prepared* (43 percent *very prepared*). More than one in five (22 percent) rated on-site responders *<u>un</u>prepared*.
- For **HF releases across the refinery**, 79 percent reported that these on-site responders were <u>less than</u> *very prepared* (22 percent *very prepared*). Again, 22 percent rated on-site responders *<u>un</u>prepared*.
- For **HF releases into the community**, 70 percent rated these responders were <u>less than</u> *very prepared* (22 percent *very prepared*). Nearly half (48 percent) rated them *<u>un</u>prepared*.

These data show declining levels of preparedness with the increased scope of HF releases. The lowest levels of preparedness were reported for potential releases into the community. This trend of lower levels of preparedness for increasing levels of potential HF releases was reported for the other three key groups of workers: off-site emergency responders, on-site nursing and other medical personnel, and local hospitals' first receivers. These are shown below.

b) Local community's off-site emergency responders

- For **HF releases limited to a work area**, 60 percent reported off-site emergency responders were <u>less than</u> *very prepared* (17 percent *very prepared*). Thirty percent (30 percent) rated them *<u>un</u>prepared* or *don't have* and 22 percent reported *don't know*.
- For **HF releases across the refinery**, 78 percent reported off-site responders were <u>less than</u> *very prepared* (9 percent *very prepared*). Almost half (48 percent) rated them *<u>un</u>prepared* or *don't have* and 13 percent reported *don't know*.
- For **HF releases into the community**, 73 percent reported these off-site responders were <u>less than</u> *very prepared* (4 percent *very prepared*). Approximately half (51 percent) rated them *<u>un</u>prepared* or *don't have* and 22 percent reported *don't know*.

c) On-site nursing and other medical personnel

- For **HF releases limited to a work area**, 69 percent reported on-site medical personnel were <u>less than</u> *very prepared* (30 percent very prepared). Thirty percent (30 percent) rated them *<u>un</u>prepared* or *don't have*.
- For **HF releases across the refinery**, 81 percent reported on-site medical personnel were <u>less than</u> *very prepared* (17 percent very prepared). Slightly over half (51 percent) rated these personnel as *<u>un</u>prepared* or *don't have*.
- For **HF releases into the community**, 78 percent reported on-site medical personnel were <u>less than</u> *very prepared* (13 percent very prepared). Over half (61 percent) rated these personnel *<u>un</u>prepared* or *don't have* and 9 percent reported *don't know*.

d) Local hospitals (or first receivers)

- For **HF releases limited to a work area**, 61 percent reported local hospitals or first receivers were less than *very prepar*ed (26 percent *very prepared*). About one in three (31 percent) rated first receivers *unprepared* and 13 percent said *don't know*.
- For **HF releases across the refinery**, 60 percent reported local hospitals or first receivers were less than *very prepared* (17 percent *very prepared*). Forty-three percent (43 percent) rated them *unprepared* and 22 percent said *don't know*.
- For **HF releases into the community**, 57 percent reported local hospitals or first receivers were less than *very prepared* (13 percent *very prepared*). Forty-four percent (44 percent) rated them *unprepared* and 30 percent said *don't know*.

5. Emergency Response Training

Prevention and preparedness for HF incidents depend on effective training. To assess prevention and preparedness training, the survey asked site survey teams how confident they were that two groups – the site's hourly work force, and the site's emergency response (ER) teams – had received the ER training they needed to respond safely to an HF release. The survey assessed this confidence for two levels of HF incidents – one in a work area where fewer than 10 workers may be seriously exposed, and one across the whole plant where dozens of workers may be seriously exposed. This assessment was limited to the two worker groups and the two levels of releases about which the site survey team would have information sufficient to make a judgment. (See Appendix B: Table B7.)

The Hourly Workforce

- For **HF releases limited to a work area**, 74 percent were less than *very confident* that the hourly work force had received training they needed to respond safely to an HF release (26 percent *very confident)*. Approximately one in four (26 percent) were *not confident* that this level of training had been achieved.
- For **HF releases across the refinery**, 95 percent were less than *very confident* (4 percent *very confident)*. Approximately half (52 percent) were *not confident*.

Site's Emergency Response Teams

- For **HF releases limited to a work area**, 79 percent were less than *very confident* that the site's team had received the needed training to respond safely to an HF release (22 percent *very confident)*. Approximately one in five (18 percent) were *not confident* that this level of training had been achieved.
- For **HF releases across the refinery**, 82 percent were less than *very confident* (17 percent *very confident)* that the site's ER team had received the needed training. Approximately one-third (34 percent) were *not confident*.

These data continued the trend noted above with diminished levels of confidence in training when considering an incident affecting the whole refinery as compared to an incident restricted to a single work area.

Need for More Training Related to HF Releases, Fires or Explosions

Large majorities of the site survey teams reported a need at their sites for additional training in both HF-related *prevention* and *emergency response*.

The Hourly Work Force

- For **preventing** HF releases or related fires or explosions, 64 percent reported the hourly work force needed more training.
- For **responding**, 83 percent reported the need for more training.

The Site's Emergency Response Teams

- For **preventing** HF releases or related fires or explosions, 78 percent reported a need for more training.
- For **responding**, 96 percent reported a need for more training.

(See Appendix B: Table B8.)

6. Staffing

The survey did not ask specific questions about staffing levels. Safe staffing is an issue not confined to alkylation units, and it will be dealt with in a future report. However, the survey included an area for comments, and a number of site survey teams wrote that staffing levels were too low to ensure safe operation and effective emergency response. The following quote exemplifies these issues:

> Staffing in the alkylation unit is lacking to the point where there are not enough qualified employees to cover the shifts. Training and break-in times have been cut to a minimum to compensate for a lack of staffing. There are only a few employees in the unit with more than a year or two [of] experience.

SUMMARY AND CONCLUSIONS

The potential impact of a large-scale HF release in a heavily populated area is so great that it may be impossible for any refiner or community to be fully prepared. Even highly effective systems sometimes fail. It would take multiple failures to trigger a major release, but the lesson of catastrophic accidents from Bhopal to the Deepwater Horizon is that multiple failures can occur. Roll the dice enough times and even the most unlikely combinations come up. The 50 American refineries using HF roll the dice every day.

Yet if the possibility of an HF disaster cannot be eliminated, it can certainly be reduced. The data presented here show that neither mandatory government regulations nor voluntary industry guidelines have convinced refiners to implement the highly effective safety systems demanded by a chemical as lethal as HF. Numerous accidents have breached one or more lines of defense. The OSHA Process Safety Management Standard is a minimum legal requirement; refineries handling HF should do much more. But OSHA has found violations of the standard in almost every refinery it has inspected. The most compelling data come from the knowledgeable and experienced refinery workers who operate HF alkylation units, or who would be expected to respond to an emergency. Their overwhelming verdict is that the current measures preventing and mitigating a major HF release are simply not good enough.

This survey shows:

- Inadequate systems to safely operate and maintain HF alkylation, storage and transfer units, to respond to emergencies and to mitigate releases.
- **I**nadequate preparation, training and drills for on-site and off-site first responders and first receivers.
- Diminishing levels of preparedness for increasingly severe accidents.
- Concern over insufficient staff for safe operation.

The only certain way to eliminate the risk of a catastrophic HF release is to eliminate HF. Safer alternatives exist, and are described in the first section of this report. Until that can be done, the safety of existing HF units must be improved.

Recommendations: Seven Steps to Safer Refineries

The USW calls on refining companies using HF to commit to seven steps.

1. **Educate Workers and the Public About the Dangers of HF.** Work with refinery workers, their unions, contract workers, first responders and first receivers, hospitals, municipal, state and federal agencies, and community and environmental groups regarding the health hazards of hydrofluoric acid including the potential consequences of minor and major releases both on- and off-site.

2. **Investigate and Learn about Safer Alternatives to HF**. Work with EPA, Homeland Security, university researchers, and domestic and foreign companies to learn from sites

using safer alternative alkylation processes in order to develop the necessary competencies for transitioning to safer alternatives to HF alkylation.

3. **Commit to Ending HF Use.** Commit to the goal of replacing all HF-using alkylation processes with safer alternatives as soon as possible.
4. **Pilot Test Alternative Solutions.** Each refining company should develop and build a test pilot alkylation reaction section. These pilot operations should use at least one of the existing safer alternative methods in at least one of their refineries. Such methods include solid acid and liquid ionic catalyst processes. They do not include modified HF or sulfuric acid which, although safer, are not safe enough and which need no pilot studies.
5. **Share Lessons to Speed Effective Transition.** Share lessons learned from these pilot operations across the industry with workers, their unions and with surrounding communities. The entire industry is needed to help move development of these alternatives forward across U.S. refining.
6. **Make Existing Operations Much Safer.** Until HF alkylation processes are replaced:
   a. Work with workers and their unions and apply all necessary corporate resources to ensure that all alkylation unit process and mitigation systems are in optimal working order, regularly inspected and tested, and subjected to rigorous audits and preventative maintenance.
   b. Work with workers, their unions, fire, emergency response, first receivers, hospitals and community/municipal leaders to engage in an open process for developing, testing and critiquing prevention, preparedness and response capabilities including periodic on-site and off-site drills.
   c. At least annually, appraise all stakeholders both within and outside refineries with a site-based record of the level of process safety, including significant operational upsets and loss of primary containment incidents, equipment failures, etc.
   d. Transition existing HF units to modified HF until non-HF units come on line.
7. **Ensure Staffing to Sufficiently Prevent, Prepare and Respond.** As is common practice in other high hazard industries like the nuclear industry, refineries must staff processes with people in sufficient numbers and with qualifications, experience and competencies necessary to ensure optimal safety during all operations including emergencies.

The government can facilitate the transition to safer processes through rigorous enforcement and oversight. Several agencies have a role to play. OSHA can enforce its Process Safety Standard; EPA, its Risk Management Program. HF units could be attractive targets for terrorists. The Department of Homeland Security lacks the authority to require inherently safer processes, but it could at least ensure that site security is adequate. The U.S. Chemical Safety and Hazard Investigation Board could undertake to investigate all HF accidents, even those with only minor injuries, and could initiate a comprehensive study of HF alkylation. Some state and local governments have the authority to address plant safety and emergency response.

No federal agency currently requires industry to consider or adopt inherently safer technology. EPA probably has the authority to do so under Section 112(r)(1) of the Clean Air Act, and a growing coalition of environmental groups, unions and former EPA officials has urged the Agency to act. A similar coalition has lobbied Congress to include a requirement to consider inherently safer technology in the Chemical Facility Anti-Terrorism Standards legislation, so far without success.

Yet it should not take compulsion for the industry to do the right thing. Company profits may vary, but overall the oil companies are the richest in the history of the world. They maintain large research operations. An industry that can design and operate equipment to drill five miles into the earth under more than a mile of seawater can surely design and operate safe alkylation units. All that is lacking is the will.

A Risk Too Great
Hydrofluoric Acid in U.S. Refineries

The Appendices to the Report of the USW Refinery Research Action Project

United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union

Pittsburgh

April 2013

Appendix A
Background Information

APPENDIX A: BACKGROUND INFORMATION

HF Hazards

HF Toxicity: HF can cause deep tissue burns that may develop over 24 hours, and may initially go unnoticed. Skin coverage with HF of 25 square inches can be fatal. When HF gets into the body, it seeks out and reacts with the body's magnesium and calcium. A chemical antidote, calcium gluconate, can limit damage to health, but a knowledgeable medic or health practitioner must administer it as soon as possible after exposure. This may include skin or respiratory treatments.

HF Exposure Limits: The level of exposure considered immediately dangerous to life and health (IDLH) is 30 parts of HF to one million parts of air (30 ppm).[25] The National Institute for Occupational Safety and Health (NIOSH) sets Recommended Exposure Limits (RELs) and the Occupational Safety and Health Administration (OSHA) sets Permissible Exposure Limits (PELs). The NIOSH REL of 3 ppm (2.5 mg/m^3) averaged over eight hours is the same as the OSHA PEL. NIOSH also recommends a ceiling exposure of 6 ppm (5 mg/m3) averaged over 15 minutes.

HF Process Controls and Modifications

HF Mitigation Systems: Water sprays may provide partial removal of HF from a vapor cloud release (25 percent to 90 percent found in controlled studies);[a] however, efficiencies in actual release conditions cannot be expected to equal those in controlled experiments.[26, 27, 28] In addition, a release of HF at a high elevation may not be detected by sensors at or near ground level. Water supplies required for these systems can also be problematic. During an HF release at the CITGO, Corpus Christi, Texas, refinery in 2009, the water spray system failed to work properly. Besides requiring huge volumes of water, often times a failure in a refinery processing unit involves multiple events such as a fire or explosion concurrent with a release. These events can disable water delivery systems either with a pumping failure due to loss of electricity or steam or damage to pipes or hydrants. In addition, these water spray systems do not function until activated and delays between releases and activation may allow large quantities of HF to be released without mitigation.[b] The 1998 Congressional Report[26] said this about water spray systems:

> Several facilities are concerned that the mitigation systems pose unworkable design requirements, do not add significantly to the protection of the public, and that the systems have the potential to cause more harm than good. (p. 105)

De-inventory systems are used to remove and neutralize HF and hydrocarbons as quickly as possible following commencement of a release, typically into a large dump tank. These systems do not control or slow the rate of release, but attempt to remove, by transfer, the large volumes that are the source of the release. Further limitations include time to activation

[a] There was a series of HF and water spray tests conducted at the Nevada Test Site in 1986 (the Goldfish Test series) and another series in 1988 conducted in a flow chamber (the Hawk Test series).

[b] API 751 states, "Early detection is critical in implementing mitigation measures for an HF alkylation unit," though it cannot be guaranteed.

following leak identification, maintenance and reliability issues, and potential failures of the de-inventory systems concurrent with failures that led to the release.

Modeling and related calculations have shown the limited potential of these three safety systems to prevent a release of HF (with or without hydrocarbons) from traveling long distances at high concentrations.[29]

Major Oil Industry Incidents

The following brief descriptions of oil industry incidents are those that have occurred in the last 10 years that demonstrate the catastrophic consequences of failed prevention and response systems.

- **Deep Water Horizon (Macondo):** As is well-known around the world, the explosions on the Deep Water Horizon on April 20, 2010, began with 126 platform workers, a refining company, an entire industry, and the U.S. government unprepared for an explosion that was to kill 11 workers and dump millions of gallons of crude oil into the Gulf of Mexico. According to the Presidential Commission that studied the disaster, events on the rig could be "traced to a series of identifiable mistakes … that reveal such systematic failures in risk management that they place in doubt the safety culture of the entire industry."[30] (p. vii) Further, Commissioners determined that the disaster, involved "risks for which neither industry nor government has been adequately prepared, but for which they can and must be prepared in the future." (p. vii)

  While the Deep Water Horizon event has been termed a "one off" event, something that does not have the likelihood to happen again, since April 20, 2010, Chevron has had a leak of similar characteristics off the coast of Brazil potentially releasing up to 3,000 barrels per day.[a] Chevron also had a rig burn off the coast of Nigeria for several weeks.[b] ConocoPhillips had a well failure in China, polluting over 6,200 square kilometers.[c] The website, http://home.versatel.nl/the_sims/rig/index.htm, provides a listing of rig explosions and fires that portrays these oil company events as occurring with an alarming regularity prior to and following the Macondo blowout.

- **Tesoro Anacortes, Wash., Refinery:** On April 2, 2010, an explosion at a Tesoro refinery killed seven workers and caused the refinery to shut down operations for six months and uncovered other deficiencies in the mechanical integrity of equipment. The director of the Washington State Department of Labor and Industry (state OSHA) stated that, "The bottom line is this incident, the explosion and these deaths were preventable." The state OSHA fined Tesoro $2.39 million for violation of standards.[31]

- **BP Texas City:** On March 23, 2005, a fiery blast at the BP refinery in Texas City, Texas killed 15 workers, injured 180 others and caused major alarm in the community. According to the U.S. Chemical Safety and Hazard Investigation Board (CSB), the agency charged with investigating and making recommendations for safer operation of facilities using highly hazardous chemicals, the incident led to financial losses exceeding $1.5 billion."[32] (p. 17) The incident resulted in over 300 citations for OSHA violations resulting in a record fine of $21 million.[33]

- **Self-reported Fires, Multiple Locations:** The USW has tracked industry self-reported fires and collected data from local union reports for the last several years. The refining

[a] http://www.alternet.org/rss/breaking_news/734330/chevron_under_fire_over_size_of_brazil_oil_spill/ (Last accessed March 12, 2013)
[b] http://www.spill-international.com/news/id731-Rig_Blowout_and_Fire_in_Offshore_Nigeria.html (Last accessed March 12, 2013)
[c] http://www.china.org.cn/business/2012-01/25/content_24479642.htm (Last accessed March 12, 2013)

industry self-reported 41 fires in 2008, 45 fires in 2009, 53 fires in 2010, 47 fires in 2011, and 41 in 2012. The number of local union reported fires are substantially higher as often the industry only reports what is required by law or what can be seen outside the fence line. There are numerous smaller fires that have caused lesser amounts of damage, but which carry the potential to have been much more serious.

HF Alkylation Unit Incidents

The following are brief descriptions of U.S. refinery incidents involving hydrofluoric acid.

- **CITGO Corpus Christi, Texas:** On March 5, 2012, an HF release reported as between 300 and 500 pounds took place at a flange that has had leaks reported back as far as September of 2011. The line had been temporarily repaired with clamps on several occasions while CITGO continued to operate.
- **Marathon Canton, Ohio:** On February 28, 2011, equipment failure caused this refinery to leak what the company estimated to be 145 pounds of hydrofluoric acid. Workers were evacuated and one worker was hospitalized. According to FireDirect, "Over the last five years, the Ohio refinery has been cited more often than all but three other refineries using HF for failing to manage hazardous processes."[34]
- **CITGO Corpus Christi, Texas:** On July 19, 2009, an explosion and fire in the alkylation unit at the CITGO refinery severely injured one worker and burned for two days. Originally CITGO estimated a release of 30 pounds based on ground-level on-site monitoring. According to the CSB, within hours 42,000 pounds of HF was released and the water spray system designed to mitigate or "knock down" the HF vapors was depleted. The refinery had to switch to a supplemental saltwater system from the nearby channel, but transfer piping ruptured and pumps failed. According to the CSB investigation, about 10 percent of the estimated 42,000 pounds of HF released traveled beyond the refinery fence line. Fortunately, due to weather conditions, the plume went into an unpopulated channel. The CSB called for third party safety auditors to examine CITGO's HF alkylation units at its Texas and Illinois refineries.[35]
- **Sunoco (Delta) Philadelphia, Pa.:** On March 11, 2009, a release of HF sent 13 contract workers to area hospitals because of exposure to a 22 pound release. Four Philadelphia area hazmat crews responded to the incident. OSHA cited the company for four "serious" violations related to the incident.
- **Fire at Giant Industries Refinery, New Mexico:** On April 8, 2004, maintenance workers set out to remove a defective pump in a hydrofluoric acid (HF) alkylation unit at the Ciniza oil refinery in Jamestown, N.M. A shut-off valve was in the open position and a release of flammable gasoline components caught fire. Six employees were injured. Four of these received burns requiring hospitalization. The incident resulted in the evacuation of non-essential employees as well as customers of a nearby commercial enterprise.[36]
- **Marathon Texas City, Texas:** On October 30, 1987 Marathon in Texas City, Texas, experienced the most potentially dangerous refinery release of HF vapors in U.S. history. A 50-square block area of the community around the refinery was evacuated and over 900 people received medical treatment for injuries. Wind direction prevented the incident from being much more disastrous.

Technical Assessment Guide (TAG) 061: Staffing Levels and Task Organisation[37]

In its TAG 061, the United Kingdom's Health and Safety Executive defines the Minimum Staff Complement as, "The number of qualified workers who must be present at all times to ensure safe operation of the nuclear facility and to ensure adequate emergency response capability." The TAG requires demonstration of adequate staffing for the licensee "to remain in control of activities that could impact on nuclear safety under all foreseeable circumstances throughout the life cycle of the facility" (p. 2). This means, "The licensee shall make and implement adequate arrangements for dealing with any accident or emergency arising on the site and their effects." (p. 3) As part of its Safety Assessment Principles the TAG states, "An organisation needs adequate human resources, which means having the necessary competences and knowledge in such numbers so as to maintain the capability to manage safety at all times, including during steady state conditions, periods of change and emergency situations." (p. 4) Further, concerning workload, the TAG states, "The workload of personnel required to fulfill safety-related actions should be analyzed and demonstrated to be reasonably achievable," and address the most resource intensive conditions feasible. Finally, the TAG calls for formal staffing assessments for *roles with high potential impact*, for staffing plans and implementation to be detailed and auditable, and for staffing adequacy to be demonstrated through operating experience and emergency exercises.

Appendix B
Tables of Findings Data

List of Tables

APPENDIX B: TABLES OF FINDINGS DATA

Table B1. Type of role/experience on site survey response teams	
Role in Refinery Work or Local Union	**Percent**
Officers and/or Executive Board members (n=23; 17% missing)	95%
Health and Safety Committee members, Health and Safety Reps., TOP Reps., and/or worker-trainers (n=23; 22% missing)	100%
Operators who work on alkylation unit(s) (n=23; 4% missing)	95%
Maintenance workers who work on alkylation unit(s) (n=23; 35% missing)	73%
Members who have served on a PHA team for alkylation unit(s) (n=23; 30% missing)	63%
Members who are on a refinery emergency response team (HAZMAT, fire brigade, etc.) (n=23; 27% missing)	88%

Table B2. Effectiveness of safety systems for maintaining the integrity of HF alkylation processes

Systems for HF Alkylation Processing	Very effective	Somewhat effective	Somewhat ineffective	Very ineffective	Don't Have	Don't Know		
Sewer systems (n=23; 0% missing)	22%	35%	22%	22%	0%	0%	44% Ineffective	79% less than very effective
Mechanical integrity of piping (n=23; 0% missing)	22%	52%	26%	0%	0%	0%	26% Ineffective	78% less than very effective
Mechanical integrity of pumps, valves, seals, vents, etc. (n=23; 0% missing)	30%	39%	30%	0%	0%	0%	30% Ineffective	69% less than very effective
Maintenance (for example, preventative, repair) (n=23; 0% missing)	30%	39%	22%	9%	0%	0%	31% Ineffective	70% less than very effective
Integrity of instrumentation (n=23; 0% missing)	35%	39%	26%	0%	0%	0%	26% Ineffective	65% less than very effective
Corrosion monitoring (n=23; 0% missing)	39%	52%	4%	0%	0%	4%	4% Ineffective	56% less than very effective
Mechanical integrity of pressured tanks, vessels (n=23; 4% missing)	45%	50%	5%	0%	0%	0%	5% Ineffective	55% less than very effective
Inspection and testing (n=23; 0% missing)	48%	39%	13%	0%	0%	0%	13% Ineffective	52% less than very effective
Mechanical integrity of atmospheric tanks, vessels* (n=16; 9% missing)	56%	38%	6%	0%	*	0%	6% Ineffective	44% less than very effective

*Only sites with "atmospheric tanks, vessels" are included; 22% said they *don't have* atmospheric tanks, vessels.
Note: Percents may not add up to 100% due to rounding

Table B3. Effectiveness of safety systems for HF-related processes, storage, and transfer systems, taken as a whole

Processes, Storage and Transfer Systems, Taken as a Whole	Very effective	Somewhat effective	Somewhat ineffective	Very ineffective	Don't Have	Ineffective (combined)	Less than very effective	Don't Know
Audit programs (n=23; 0% missing)	9%	52%	13%	17%	0%	30% Ineffective	82% less than very effective	9%
Health hazard information and education for non-HF alkylation personnel (n=23; 0% missing)	17%	43%	30%	9%	0%	39% Ineffective	82% less than very effective	0%
Maintenance (preventative and repair) (n=23; 0% missing)	22%	52%	17%	9%	0%	26% Ineffective	78% less than very effective	0%
Operating manuals and procedures (n=23; 0% missing)	26%	48%	17%	4%	0%	21% Ineffective	69% less than very effective	4%
Utility systems (n=23; 0% missing)	35%	52%	4%	9%	0%	13% Ineffective	65% less than very effective	0%
Alkylation pre-start-up safety reviews (n=23; 0% missing)	35%	57%	0%	9%	0%	9% Ineffective	66% less than very effective	0%
Process hazard analysis (PHA) (n=23; 0% missing)	39%	43%	13%	4%	9%	26% Ineffective/Don't have	69% less than very effective	0%
Leak detection and repair (n=23; 0% missing)	39%	48%	9%	4%	0%	13% Ineffective	61% less than very effective	0%
Strictly controlled access to alkylation units (n=23; 0% missing)	43%	22%	9%	22%	4%	35% Ineffective/Don't have	57% less than very effective	0%
Controlled relief and neutralization systems (n=23; 0% missing)	52%	35%	0%	9%	0%	9% Ineffective	44% less than very effective	4%
Health hazard information and education for HF unit workers (n=23; 0% missing)	65%	22%	4%	9%	0%	13% Ineffective	35% less than very effective	0%

Note: Percents may not add up to 100% due to rounding

Table B4. Effectiveness of HF emergency mitigation and response systems

Emergency System	Very effective	Somewhat effective	Somewhat ineffective	Very ineffective	Don't Have	Don't Know
Alarms and notification systems – off-site (n=23; 0% missing)	9%	35%	9%	4%	35%	9%
			48% Ineffective/Don't have			
		83% Less than very effective				
Utility back-up systems (n=23; 0% missing)	13%	39%	13%	17%	17%	0%
			47% Ineffective/Don't have			
		86% Less than very effective				
Site's emergency field drills in preparing for an HF release up to and including a worst-case (n=23; 0% missing)	17%	30%	4%	26%	13%	9%
			43% Ineffective/Don't have			
		73% Less than very effective				
Safe havens (n=23; 0% missing)`	22%	30%	9%	13%	22%	4%
			44% Ineffective/Don't have			
		74% Less than very effective				
Diking (n=23; 0% missing)	22%	39%	13%	13%	13%	0%
			39% Ineffective/Don't have			
		78% Less than very effective				
Chemical neutralization (n=23; 4% missing)	32%	41%	0%	5%	23%	0%
			28% Ineffective/Don't have			
		69% Less than very effective				
Fire suppression (n=23; 0% missing)	39%	35%	17%	0%	9%	0%
			26% Ineffective/Don't have			
		61% Less than very effective				
Remotely operated block valves for unit isolation (n=23; 0% missing)	39%	52%	4%	4%	0%	0%
			8% Ineffective			
		60% Less than very effective				
Water mitigation, curtain /deluge (n=23; 0% missing)	43%	39%	13%	4%	0%	0%
			17% Ineffective			
		56% Less than very effective				
Overall emergency shutdown and isolation systems (n=23; 0% missing)	52%	35%	4%	4%	0%	4%
			8% Ineffective			
		43% Less than very effective				

<table>
<tr><th colspan="7">Table B4. Effectiveness of HF emergency mitigation and response systems</th></tr>
<tr><th>Emergency System</th><th>Very effective</th><th>Somewhat effective</th><th>Somewhat <u>in</u>effective</th><th>Very <u>in</u>effective</th><th>Don't Have</th><th>Don't Know</th></tr>
<tr><td rowspan="3">Alarms and notification systems -- on-site (n=23; 0% missing)</td><td rowspan="3">57%</td><td rowspan="2">30%</td><td>9%</td><td>4%</td><td>0%</td><td rowspan="3">0%</td></tr>
<tr><td colspan="3">13% <u>In</u>effective</td></tr>
<tr><td colspan="4">43% <u>Less than</u> very effective</td></tr>
<tr><td rowspan="3">Emergency dump (catalyst/HF rapid transfer systems) (n=23; 0% missing)</td><td rowspan="3">57%</td><td rowspan="2">17%</td><td>0%</td><td>4%</td><td>9%</td><td rowspan="3">13%</td></tr>
<tr><td colspan="3">13% <u>In</u>effective/Don’t have</td></tr>
<tr><td colspan="4">40% <u>Less than</u> very effective</td></tr>
</table>

Note: Percents may not add up to 100% due to rounding

<table>
<tr><th colspan="7">Table B5. How prepared is the site regarding emergency personal protective equipment (PPE).</th></tr>
<tr><th></th><th>Very prepared</th><th>Somewhat prepared</th><th>Somewhat unprepared</th><th>Very unprepared</th><th>Don't Have</th><th>Don't Know</th></tr>
<tr><td rowspan="3">PPE for every site employee who may need it in an HF-related emergency (n=23; 0% missing)</td><td rowspan="3">35%</td><td rowspan="2">26%</td><td>17%</td><td>22%</td><td>0%</td><td rowspan="3">0%</td></tr>
<tr><td colspan="3">39% Unprepared</td></tr>
<tr><td colspan="4">65% <u>less than</u> very effective</td></tr>
</table>

Note: Percents may not add up to 100% due to rounding

Table B6. How prepared is each group to respond to an HF release. (Scope listed)						
Group	**Very prepared**	**Somewhat prepared**	**Somewhat unprepared**	**Very unprepared**	**Don't Have**	**Don't Know**
In a work area (where fewer than 10 workers may be seriously exposed)						
Local (off-site) emergency responders (n=23; 0% missing)	17%	30%	9%	17%	4%	22%
			30% Unprepared/Don't have			
		60% less than very prepared				
Local hospitals (n=23; 0% missing)	26%	30%	22%	9%	0%	13%
			31% Unprepared			
		61% less than very prepared				
Site's nursing and other medical personnel (n=23; 0% missing)	30%	39%	13%	13%	4%	0%
			30% Unprepared/Don't have			
		69% less than very prepared				
Site's emergency response team, hazmat team, or fire brigade (n=23; 0% missing)	43%	35%	13%	9%	0%	0%
			22% Unprepared			
		57% less than very prepared				
Across the whole plant site (where dozens of workers may be seriously exposed)						
Local (off-site) emergency responders (n=23; 0% missing)	9%	30%	22%	22%	4%	13%
			48% Unprepared/Don't have			
		78% less than very prepared				
Local hospitals (n=23; 0% missing)	17%	17%	30%	13%	0%	22%
			43% Unprepared			
		60% less than very prepared				
Site's nursing and other medical personnel (n=23; 0% missing)	17%	30%	30%	17%	4%	0%
			51% Unprepared/Don't have			
		80% less than very prepared				
Site's emergency response team, hazmat team, or fire brigade (n=23; 0% missing)	22%	57%	9%	13%	0%	0%
			22% Unprepared			
		79% less than very prepared				

Table B6. How prepared is each group to respond to an HF release. (Scope listed)						
Group	**Very prepared**	**Somewhat prepared**	**Somewhat unprepared**	**Very unprepared**	**Don't Have**	**Don't Know**
In the community (where dozens of workers and community members may be seriously exposed)						
Local (off-site) emergency responders (n=23; 0% missing)	4%	22%	17%	30%	4%	22%
			51% Unprepared/Don't have			
		73% less than very prepared				
Local hospitals (n=23; 0% missing)	13%	13%	22%	22%	0%	30%
			44% Unprepared			
		57% less than very prepared				
Site's nursing and other medical personnel (n=23; 0% missing)	13%	17%	22%	35%	4%	9%
			61% Unprepared/Don't have			
		78% less than very prepared				
Site's emergency response team, hazmat team, or fire brigade (n=23; 0% missing)	22%	22%	22%	26%	0%	9%
			48% Unprepared			
		70% less than very prepared				

Note: Percents may not add up to 100% due to rounding

Table B7. Confidence that the groups have received the training they need to respond safely to an HF release.				
	Very confident	**Somewhat confident**	**Somewhat not confident**	**Very not confident**
In a work area (where fewer than 10 workers may be seriously exposed)				
Hourly workforce (n=23; 0% missing)	26%	48%	17%	9%
			26% Not confident	
		74% Less than very confident		
Site's emergency response team, hazmat team, or fire brigade (n=23; 0% missing)	22%	61%	9%	9%
			18% Not confident	
		79% Less than very confident		
Across the whole plant site (where dozens of workers may be seriously exposed)				
Hourly workforce (n=23; 0% missing)	4%	43%	30%	22%
			52% Not confident	
		95% Less than very confident		
Site's emergency response team, hazmat team, or fire brigade (n=23; 0% missing)	17%	48%	17%	17%
			34% Not confident	
		82% Less than very confident		

Note: Percents may not add up to 100% due to rounding

Table B8. Need for additional training in HF hazard prevention		
	Yes	**No**
Hourly workforce		
Responding to HF releases or related fires or explosions (possibly involving other hazardous chemicals) (n=23; 0% missing)	83%	17%
Preventing HF releases or related fires or explosions (possibly involving other hazardous chemicals) (n=22; 4% missing)	64%	36%
Emergency response team, hazmat team, or fire brigade		
Responding to HF releases or related fires or explosions (possibly involving other hazardous chemicals) (n=23; 0% missing)	96%	4%
Preventing HF releases or related fires or explosions (possibly involving other hazardous chemicals) (n=23; 0% missing)	78%	22%

Note: Percents may not add up to 100% due to rounding

Appendix C:

HF Using Refineries and At Risk Locations and Populations

Table C1.[*] 50 HF-using Refiners and Locations and Size of Populations at Risk[**]

Oil Company	No. of HF Refineries		Refinery Locations	Number of persons at risk	
	Total	USW		Workers Represented by USW [†]	Community[‡]
Valero	8	2	Wilmington, CA; Ardmore, OK; Paulsboro, NJ; Memphis, TN (USW); Port Arthur, TX (USW); Texas City, TX; Corpus Christi, TX; Three Rivers, TX	583	5,575,700
Marathon	6	3	Robinson, IL; Catlettsburg, KY (USW); Garyville, LA; St. Paul Park, MN; Canton, OH (USW); Texas City, TX (USW)	779	4,448,700
ConocoPhillips[††]	7	5	Belle Chasse, LA (USW); Billings, MT (USW); Ponca City, OK (USW); Trainer, PA (USW); Borger, TX; Sweeny, TX; Ferndale, WA (USW)	1,069	3,655,800
CITGO	2	2	Lemont, IL (USW); Corpus Christi, TX (USW)	422	3,320,000
ExxonMobil	4	3	Torrance CA (USW); Channahon, IL; Chalmette, LA (USW); Billings, MT (USW)	750	2,414,600
Sunoco[††]	1	1	Philadelphia, PA (USW)	611	1,308,400
Murphy[††]	2	1	Meraux, LA (USW); Superior WI	168	1,236,000
ChevronTexaco	1	1	Salt Lake City, UT (USW)	115	1,100,000
Houston Refining	1	1	Pasadena, TX (USW)	476	650,000
BP	1	1	Texas City, TX (USW)	896	550,000
Placid Refining Co. LLC-Port Allen Refinery	1	0	Port Allen, LA	‡‡	440,200
Flying J	1	1	North Salt Lake, UT (USW)	95	376,000
Flint Hills Resources, LP-CC West Refinery	1	0	Corpus Christi, TX;	‡‡	349,900
Holly/Frontier	3	3	El Dorado, KS (USW); Woods Cross, UT (USW); Cheyenne, WY (USW)	465	308,100
CHS Laurel Refinery	1	1	Laurel, MT (USW)	163	85,000
Connacher Oil/ Montana Refining Co. Inc.	1	1	Great Falls, MT (USW)	48	69,000
Tesoro	1	1	Mandan, ND (USW)	132	68,000
Coffeyville Resources (CVR Energy)	1	0	Coffeyville, KS	‡‡	40,700
Wynnewood Refining Company	1	0	Wynnewood, OK	‡‡	40,000
Alon	1	0	Big Spring, TX	‡‡	38,000
Navajo Refining Company	1	0	Artesia, NM	‡‡	16,000
National Cooperative	1	1	McPherson, KS (USW)	132	20,100
Countrymark Co-op LLP	1	0	Mt. Vernon, IN	‡‡	8,000
Gallup Refinery	1	0	Jamestown, NM	‡‡	4,800
Wyoming Refining Company	1	0	Newcastle, WY	‡‡	3,100
Totals	**50**	**28**		**6,904**	**26,126,100**

*Data is in part from the Center for Public Integrity. **Ranked by number of community members at risk. USW indicates workers at the site are represented by USW. [†] Additional thousands of others non-represented employees are at risk. [‡] Reported by refining companies to EPA. [‡‡] Not USW, not available. [††] Since data was collected the Conoco refinery in Trainer, PA was purchased by Delta Airlines and will be operated by a subsidiary, Monroe Energy; the Sonoco refinery has come under the ownership of Philadelphia Energy Solutions, a joint venture of the Carlyle Group and Sunoco; Calumet Lubricants purchased the Murphy Oil, Superior, WI refinery; and Valero Energy Corporation purchased the Murphy Oil, Meraux, LA refinery.

Table C2.* HF-using Refineries in Metropolitan Areas (Over 500,000 at risk)*

City/Area	Number of Refineries	Refinery Locations	No of community members at risk†	Refining Companies
Philadelphia‡	3	Paulsboro, NJ; Philadelphia, PA (USW); Trainer, PA (USW)	6,878,400	Valero, Sunoco,†† Conoco††
Chicago	2	Channahon, IL; Lemont, IL (USW)	4,075,900	Exxon, CITGO
New Orleans	4	Belle Chasse (USW), LA; Chalmette, LA; Garyville, LA; Meraux, LA (USW)	3,346,200	Conoco, Exxon, Marathon, Murphy††
Texas City	4	Texas City, TX (USW); Pasadena, TX (USW)	2,280,000	Crown, BP, Marathon, Valero
Minneapolis	1	St. Paul Park	2,200,000	Marathon
Salt Lake City	3	Salt Lake City, UT (USW); North Salt Lake, UT (USW); Woods Cross, UT (USW)	1,692,300	Chevron, Flying J, Holly/Frontier
Canton, OH	1	Canton, OH (USW)	940,000	Marathon
Memphis	1	Memphis, TN (USW)	792,000	Valero
Totals	**19**		**22,204,800**	

*Data is in part from the Center for Public Integrity. **Ranked by number of community members at risk. † Reported by Refining Companies to EPA. †† Since data was collected the Conoco refinery in Trainer, PA was purchased by Delta Airlines and will be operated by a subsidiary, Monroe Energy; the Sonoco refinery has come under the ownership of Philadelphia Energy Solutions, a joint venture of the Carlyle Group and Sunoco; and Valero Energy Corporation purchased the Murphy Oil, Meraux, LA refinery.

REFERENCES

[1] Center for Public Integrity. 2010. Data gathered in October 2010 at U.S. EPA Headquarters by Center for Public Integrity staff.

[2] Stratford Engineering. 2011. Safety Issues in Alkylation Units. http://stratfordengineering.com/articles/safety-issues-in-alkylation-units. (Last accessed March 12, 2013).

[3] Blewitt DN, Yohn JF, Koopman RP, and Brown TC. 1987. Conduct of Anhydrous Hydrofluoric Acid Spill Experiments. Presented at the International Conference on Vapor Cloud Modeling, Boston, MA. Nov. 2-4. Amoco Corporation Chicago, IL and Lawrence Livermore National Laboratory, Livermore, CA.

[4] American Petroleum Institute. 2007. Safe Operation of Hydrofluoric Acid Alkylation Units: Recommended Practice (RP) 751, 3rd Ed. Washington, D.C.: API Publishing Services.

[5] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 2011. Deep Water The Gulf Oil Disaster and the Future of Offshore Drilling Report to the President. http://www.oilspillcommission.gov/final-report. (Last accessed March 12, 2013).

[6] Columbia Accident Investigation Board. 2003. Report Volume 1 of the Columbia Accident Investigation Board. http://www.nasa.gov/columbia/home/CAIB_Vol1.html. (Last accessed March 12, 2013).

[7] Flynn S. 2007. The Edge of Disaster. New York: Random House.

[8] Flynn S. 2007. The Next Attack. Washington, D.C.: The Washington Monthly. http://www.washingtonmonthly.com/features/2007/0703.flynn.html. (Last accessed March 12, 2013).

[9] Rosenthal I, Kleindorfer PR, and Elliott MR. 2006. Predicting and confirming the effectiveness of systems for managing low-probability chemical process risks. Process Safety Progress. (Vol.25, No.2), 135-155.

[10] Belke JC. 1998. Recurring Causes of Recent Chemical Accidents. International Conference on Workshop Reliability and Risk Management, San Antonio TX, 1998 (1996-2009, The Plant Maintenance Resource Center: http://www.plant-maintenance.com/articles/ccps.shtml). (Last accessed March 12, 2013).

[11] Belke J. 2000. Chemical accident risks in U.S. industry: A preliminary analysis of accident risk data from U.S. hazardous facilities, U.S. Environmental Protection Agency, Washington, D. C. http://www.acusafe.com/Incidents/Statistics/CEPPO-RMPINFO.pdf. (Last accessed March 12, 2013).

[12] Elliott MR, Kleindorfer PR, Dubois J, Wang Y, and Rosenthal I. 2008. Linking OII and RMP*Info Data: Does everyday safety prevent catastrophic loss? International Journal of Risk Assessment and Management. Vol. 10, Nos. 1/2:130-146. http://opim.wharton.upenn.edu/risk/library/2007Elliott,PRK,etal_EverydaySafety.pdf. (Last accessed March 12, 2013).

[13] Barab J. 2010. "Learning From Industry Mistakes." Deputy Assistant Secretary for OSHA, Presentation to the National Petroleum Refiners Association, National Safety Conference. San Antonio, TX, May 19. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=SPEECHES&p_id=2218. (Last accessed March 12, 2013).

[14] U.S. Occupational Safety and Health Administration (OSHA). 2007. CPL 03-00-004, Petroleum Refinery Process Safety Management National Emphasis Program. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=3589&p_table=DIRECTIVES. (Last accessed March 12, 2013).

[15] U.S. Chemical Safety and Hazard Investigation Board (CSB). News Release. April 1, 2011. http://www.csb.gov/assets/news/document/Tesoro_Anniversary_-_Safety_Message_-_Final.pdf.

[16] McQuiston TH, Lippin TM, Bradley-Bull K, Anderson J, Beach J, Beach J, Beevers G, Frederic R, Frederick J, Greene T, Hoffman T, Lefton J, Nibarger K, Renner R, Taylor W, Wright M. 2009. Beyond Texas City: The state of process safety in the unionized U.S. oil refining industry. New Solutions 19(3) 271-288.

[17] Baker J. et al. 2007. The Report of the BP U.S. Refineries Independent Safety Review Panel (January 30). http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/SP/STAGING/local_assets/assets/pdfs/Baker_panel_report.pdf. (Last accessed March 12, 2013).

[18] Persensky J, Szabo A, Plott C, Engh T, and Barnes V. 2005. Guidance for Assessing Exemption Requests From the Nuclear Power Plant; Licensed Operator Staffing Requirements Specified in 10 CFR 50.54 (m). U.S. Nuclear Regulatory Commission.

http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1791/sr-1791.pdf. (Last accessed March 12, 2013).

[19] Siroris AG and Moore-Ede M. 2013. Circadian White Paper: Staffing Levels, A Key to Managing Risk in 24/7 Operations. (1st Ed). Stoneham, MA. http://www.circadian.com/landing-page/white-paper-staffing-levels.html

[20] International Atomic Energy Agency (IAEA). IAEA Safety Guide 'The Operating Organization for Nuclear Power Plants', NS-G-2.4, IAEA, 2008. IAEA Safety Guide 'Conduct of Operations at Nuclear Power Plants', NS-G-2.14, IAEA, 2008. IAEA-TECDOC-1052 NPP Organization and staffing for improved performance – lessons learned, IAEA, 1998.

[21] Kletz T. 1998. Process Plants: A Handbook For Inherently Safer Design. Philadelphia, PA: Taylor and Francis.

[22] Crowl DA (Ed). 1996. Inherently Safer Chemical Processes: A Life Cycle Approach. New York: American Institute of Chemical Engineers.

[23] PetroChina Lanzhou Petrochemical Company.

[24] Liu Z, Zhang R, Xu C and Xia R. 2006. Ionic liquid alkylation process produces high-quality gasoline. Oil and Gas Journal. October 23: 52-56.

[25] National Institute for Occupational Safety and Health (NIOSH) Pocket Guide. Hydrogen fluoride. http://www.cdc.gov/niosh/npg/npgd0334.html. (Last accessed March 12, 2013).

[26] Blewitt DN, Yohn JF, Koopman RP, Brown TC, and Hague WJ. 1987. "Effectiveness of Water Sprays on Mitigating Anhydrous Hydrofluoric Acid Releases," Proceedings of International Conference on Vapor Cloud Modeling, CCPS, Cambridge, MA, 2-4 November, pp. 155-180.

[27] U.S. EPA. 1998. Hydrogen Fluoride Study Report to Congress Section 112(n)(6) Clean Air Act as Amended Final Report. EPA OSWER, Office of Emergency Management. http://www.epa.gov/osweroe1/docs/chem/hydro.pdf. (Last accessed July 17, 2012).

[28] Slavas JP. 1991. HF mitigation by water sprays. BETE Fog Nozzle, Inc. Presentation at the PETRO-SAFE Conference, Houston, TX. http://www.bete.com/pdfs/BETE_HF_mitigation.pdf. (Last accessed March 12, 2013).

[29] Cornwell JB, Johnson DW. 1995. Effectiveness of mitigation systems in reducing hazards of hydrogen fluoride leaks. First Risk Control Engineering Seminar, Maracaibo, Venezuela. http://www.questconsult.com/resources/papers/pdf/paper45.pdf. (Last accessed March 12, 2013).

[30] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 2011. Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling. Report to the President. www.oilspillcommission.gov. (Last accessed March 12, 2013).

[31] Malik NS. 2010. Tesoro fined $2.4 million for deadly blast at refinery. Wall Street Journal (October 4). http://online.wsj.com/article/SB10001424052748704631504575532281314909438.html. (Last accessed March 12, 2013).

[32] U.S. Chemical Safety and Hazard Investigation Board (CSB). 2007. Investigation Report: Refinery Explosion and Fire (15 Killed, 180 Injured). BP, Texas City, Texas, March 23, 2005. Washington, D.C.: CSB. March 2007. http://www.csb.gov/assets/document/CSBFinalReportBP.pdf. (Last accessed March 12, 2013).

[33] U.S. OSHA. 2005. OSHA Fines BP Products North America More Than $21 Million Following Texas City Explosion. September 22, 2005.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=11589&p_table=NEWS_RELEASES. (Last accessed March 12, 2013).

[34] FireDirect. 2011. equipment failure at refinery leads to toxic HF release (March 3). http://www.firedirect.net/index.php/2011/03/equipment-failure-at-refinery-leads-to-toxic-hf-release/. . (Last accessed March 12, 2013).

[35] U.S. CSB. 2009. CSB Issues Urgent Recommendations to CITGO; Finds Inadequate Hydrogen Fluoride Water Mitigation System during Corpus Christi Refinery Fire Last July. December 9. http://www.csb.gov/newsroom/detail.aspx?nid=298. (Last accessed March 12, 2013).

[36] U.S. CSB. 2005. Case Study: Oil Refinery Fire And Explosion, Giant Industries' Ciniza Oil Refinery. http://www.csb.gov/assets/document/Giant_Case_Study.pdf. (Last accessed March 12, 2013).

[37] U.K. Health and Safety Executive. 2010. Technical Assessment Guide (TAG): Staffing Levels and Task Organisation. February 22. This TAG is intended to supplement the guidance in T/AST/065, The Function and Content of the Nuclear Baseline. WENRA Reactor Harmonisation Working Group: Reactor Safety Reference Levels, WENRA, January 2008. http://www.hse.gov.uk/nuclear/operational/tech_asst_guides/tast061.pdf. (Last accessed March 12, 2013).

The report is available at:
http://assets.usw.org/resources/hse/pdf/A-Risk-Too-Great.pdf

beyond TEXAS CITY

The State of Process Safety in the Unionized U.S. Oil Refining Industry

A Report on the USW Refinery Survey
October 2007

TONY MAZZOCCHI CENTER
FOR HEALTH, SAFETY AND ENVIRONMENTAL EDUCATION
A PROJECT OF THE UNITED STEELWORKERS AND THE LABOR INSTITUTE

UNITED STEELWORKERS
USW™
UNITY AND STRENGTH FOR WORKERS

New Perspectives
CONSULTING GROUP INC

Beyond Texas City

The State of Process Safety in the Unionized U.S. Oil Refining Industry

A Report on the USW Refinery Survey

October 2007

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Bold indicates current or former oil refinery worker. Collectively, these workers represent over 200 years of refinery experience, much of that focused on refinery health and safety issues. USW is the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union

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Tony Mazzocchi Center, United Steelworkers, New Perspectives

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Executive Summary

Introduction

On March 23, 2005, a fiery blast at the BP refinery in Texas City, Texas killed 15 workers, injured 180 others and caused major alarm in the community. According to the U.S. Chemical Safety and Hazard Investigation Board (CSB), the incident led to financial losses exceeding $1.5 billion."[1] (p. 17) The incident resulted in over 300 citations for OSHA violations resulting in a record fine of $21 million.[2] The magnitude of this catastrophe marks it as one of the most damaging process safety accidents in U.S. history. It was also the biggest industrial disaster since passage of the Occupational Safety and Health Administration's (OSHA's) 1992 standard on Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119).

In January 2006, nine months following the Texas City disaster, the Tony Mazzocchi Center for Health, Safety and Environmental Education[a] (TMC) sent a 64-item, mail-back survey to local unions at each of 71 United Steelworkers (USW)-represented refineries.

The survey sought to determine the extent to which conditions similar to those that led to the BP Texas City catastrophe exist at the nation's other refineries and what is being done to correct those conditions. Accordingly, it asked about conditions, processes, practices, and actions relevant to prevention of, preparedness for, and response to possible future incidents resulting in fires, explosions, or large releases of highly hazardous chemicals. Local union leaders were asked to engage persons from the local union who were knowledgeable about refinery health and safety issues to complete the survey sent to their site.

The findings that form the basis for this paper's conclusions on the "The State of Process Safety in the Unionized U.S. Oil Refining Industry" were obtained by means of a survey described below and a review of the literature which focuses on existing regulations, guidelines and lessons from previous refinery disasters.

The survey used in this study focused on four conditions and practices found to be key contributors to the occurrence of the 2005 Texas City accident and its terrible consequences. The four key contributors, hereinafter referred to as *highly hazardous conditions*, included: 1) use of atmospheric vents on process units, 2) failed management of

[a] The Tony Mazzocchi Center is a partnership between the United Steelworkers (USW) and the Labor Institute.

instrumentation and alarm systems, 3) siting of trailers and unprotected buildings near high risk process facilities, and 4) allowance of non-essential personnel in high risk areas during start-up and shutdown. (Of the four *highly hazardous conditions*, information and data on three (vents, trailers, and non-essential personnel) lend themselves most readily to survey measurement). Therefore, some findings focus on these three *highly hazardous conditions* while others focus on all four. Researchers also reviewed literature which focuses on existing regulations and guidelines and lessons from previous refinery disasters.

A participatory action research team carried out this study. The team included: USW rank and file workers, including nine current or former refinery workers; USW Health, Safety and Environment Department and TMC staff; USW International Union leadership; and education and evaluation consultants from New Perspectives Consulting Group and the Labor Institute.

The survey achieved a response rate of 72% (51 of 71 USW U.S. refinery sites). The 51 responding sites represented: 34% of the United States' 149 refineries and 49% of the U.S. refining capacity. Twenty-two (22) different refining companies in 19 U.S. states and one territory operated these refineries, including industry giants such as ExxonMobil and Shell-Motiva and independents such as Flying J.

Findings

Highly Hazardous Conditions Similar to Those Found at BP Texas City Are Pervasive in US Refineries: Ninety percent (90%) of the 51 refineries reported the presence of at least one of the three targeted *highly hazardous conditions* (43% reported three *highly hazardous conditions,* 35% reported two conditions, and 12% reported one *condition*). Seventy-eight percent (78%) placed trailers or other unprotected buildings in hazardous areas, 70% had non-essential personnel present in vulnerable areas during start-ups and shutdowns, and 66% had atmospheric vents on process units.

There Remains an Alarming Potential for Future Disasters: The findings indicate that the U.S. refinery industry remains plagued by the threat of refinery catastrophes like the fires and explosions that engulfed workers at BP's Texas City refinery – catastrophes that are preventable. More specifically, 61% of respondents (from 31 refineries) reported <u>at least one</u> incident or near miss involving at least one of the targeted four *highly hazardous conditions* in the past three years. One in ten sites experienced <u>one or more</u> incidents or near misses involving <u>all four</u> *highly hazardous conditions* (10% involving three conditions, 14% involving two conditions, and 27% involving one condition).

Industry Response Since Texas City Has Been Anemic: The heightened risks present during refinery process start-ups and shutdowns demand that all safety systems be highly reliable and at peak effectiveness. In contrast, findings from this study suggest that the stark and hard lessons from the myriad of refinery incidents and near misses prior to and including BP Texas City have been widely ignored by refiners.

The survey findings highlight that following the Texas City disaster a substantial majority of refineries with one or more of the four *highly hazardous conditions* either took *no action* or took actions judged <u>less than</u> *very effective* (*somewhat effective, somewhat <u>in</u>ef-*

fective, or *very ineffective*). For replacing atmospheric vents, 79% took *no action* or less than *very effective action*.[a] For improving management of instrumentation and alarms, 65% took *no action* or less than *very effective action*.[b] For removing trailers or other unprotected buildings, 59% took *no action* or less than *very effective action*.[c] For keeping non-essential personnel out of hazardous areas, 63% took *no action* or less than *very effective action*.[d]

The Letter and the Spirit of OSHA's Process Safety Standard Remain Unfulfilled: A solid majority of respondents individually rated each of 16 process safety systems for start-up or shutdowns as less than *very effective.* More than three-quarters of respondents rated 10 of the 16 systems as less than *very effective.* Further, 87% rated the overall management of process safety systems at their sites as less than *very effective*.[e]

Pre-start-up safety reviews are included in OSHA's Process Safety Management standard. The prevalence of the four *highly hazardous conditions* and related incidents and near misses during process start-ups and shutdowns, as reported by respondents, indicates that at many sites pre-start-up safety reviews lack the robustness necessary to ensure safe operation.

Inadequate Staffing and Poor Work Organization Increase the Risk of Catastrophic Accidents: *Work organization and staffing* was one of the 16 process safety systems for start-up and shutdowns examined. Virtually every safety system examined in this study is dependent on the presence of highly qualified employees in sufficient numbers to handle normal, abnormal, upset, and emergency situations. However, at almost nine out of 10 sites respondents rated work organization and staffing as less than *very effective.*[f]

Contractors are a very substantial part of the work force at most every refinery. The 15 workers who died in the BP Texas City disaster were all contractor workers. Lessons from previous disasters have shown that contractor workers need to play important roles in prevention. In this study the preparedness of contractor workers to contribute to incident prevention received the poorest ratings of any item in the survey.

Refineries are Not Sufficiently Prepared for Emergencies: It appears that the refining industry is under-prepared for hazardous materials emergencies. While 30% of re-

[a] Respondents reported effectiveness of actions as follows: 3% *very effective,* 18% *somewhat effective*, 3% *somewhat ineffective*, 0% *very ineffective*. 58% took *no action*, and 18% reported *don't know* or data were missing.
[b] Respondents reported effectiveness of actions as follows: 12% *very effective,* 24% *somewhat effective*, 6% *somewhat ineffective*, 0% *very ineffective*. 35% took *no action*, and 24% reported *don't know* or data were missing.
[c] Respondents reported effectiveness of actions as follows: 38% *very effective,* 33% *somewhat effective*, 5% *somewhat ineffective*, 8% *very ineffective*. 13% took *no action*, and 5% reported *don't know* or data were missing.
[d] Respondents reported effectiveness of actions as follows: 23% *very effective,* 17% *somewhat effective*, 0% *somewhat ineffective*, 0% *very ineffective*. 46% took *no action*, and 14% reported *don't know* or data were missing.
[e] Respondents reported overall effectiveness of management of process safety systems as follows: 13% *very effective,* 66% *somewhat effective*, 17% *somewhat ineffective*, 4% *very ineffective*, 0% *don't know*.
[f] Respondents rated work organization and staffing as follows: 12% *very effective,* 33% *somewhat effective*, 43% *somewhat ineffective*, 12% *very ineffective,* 0% *don't know*, 0% missing.

spondents rated their sites as *very prepared,* some of the highest ratings in this entire study, the remaining 70% reported that their refineries were less than *very prepared.*[a]

Emergency response training and frequent drills are critical to having a work force prepared to respond to a hazardous materials incident. While nearly all study respondents reported that emergency response teams, hazmat teams, or fire brigades had received training at their sites in the previous 12 months, only 77% of sites reported emergency response training for the general plant population in the past year. Thus, workers at approximately one in four refineries labor in highly volatile situations without up-to-date training. Further, only one-quarter of respondents reported being *very confident* that the work force at their site had received the training it needed to respond safely to a serious hazardous materials incident or emergency.[b]

The Oil Industry Should Promptly Address Critical Deficiencies in Process Safety Management: Process changes, replacement of antiquated equipment, preventative maintenance, adequate staffing, and other measures necessary for high reliability and excellence in process safety all require financial investments. While oil refiners, like BP, are reporting enormous, record-breaking profits, the U.S. Chemical Safety and Hazard Investigation Board (CSB) recently reported that cost-cutting "impaired" process safety performance in Texas City.[1] The refinery industry must use its vast wealth to take responsibility for preventing future horrors such as the BP Texas City catastrophe.

Proactive OSHA Regulation and Enforcement Are Essential: In sharp contrast to other high hazard industries such as aerospace, aviation, and nuclear power which are specifically required to perform to very high standards, government regulators have not yet demanded that the refining industry invest the necessary resources to be fully protected and secured. For example, policymakers and the public would find it unacceptable if there were widespread reports from airline pilots or mechanics that take-offs and landings were occurring with less than fully effective critical safety systems. However, this study's findings suggest such "take-offs" and "landings" occur regularly at refineries, thereby threatening the lives of hundreds or thousands of workers, nearby community members and the environment. Given that petroleum refineries are a vital part of the nation's energy infrastructure, prompt government intervention including strengthened OSHA and EPA standards and rigorous enforcement must be put in place.

In particular, OSHA should update and strengthen its 1992 standard on "Process Safety Management of Highly Hazardous Chemicals" (29 CFR 1910.119). For example, facilities should be required to report to OSHA when their use of highly hazardous chemicals in large quantities meets the standards' provisions for coverage. The standard currently covers flammable, explosive and toxic chemicals, but not chemicals that can undergo a catastrophic runaway reaction. The CSB has recommended that OSHA correct this deficiency, but the Agency has taken no action. The rulemaking should also consider incorporating the process safety metrics and the safe siting guidelines currently under development. The Agency could also write many of the urgent and critical actions listed in the next section into regulatory language.

[a] Respondents reported preparedness to respond to a hazardous materials incident or emergency as follows: 30% *very prepared,* 58% *somewhat prepared*, 10% *somewhat unprepared*, 2% *very unprepared, 6%* missing.
[b] Respondents reported their confidence as follows: 25% *very confident,* 51% *somewhat confident*, 22% *somewhat unconfident*, 2% *very unconfident,* 4% missing.

Changes in other regulations would also be useful. In particular, all facilities that employ outside contractors should be required to keep a log of injuries and illnesses for all workers on the site. It is absurd that BP was not required to report any of the workers killed in its Texas City disaster on its log of occupational injuries and illnesses. This was the case because BP did not directly employ any of those killed—they were contractor employees.

Of course, OSHA standards are useless without strong enforcement. At the time of the BP disaster, OSHA had few inspectors trained to enforce its Process Safety Standard. The Agency has begun to train additional inspectors, but more could and needs to be done. Even with the additional inspectors, OSHA must commit to using the standard vigorously. Too often, OSHA measures its productivity by comparing the number of inspections and citations with the inspection time needed to generate them. However, process safety inspections are complicated and time consuming. As such, they do not fit well into this naïve measure of productivity. OSHA needs to ensure that it gives such inspections the time, resources and high priority they deserve.

The Oil Industry Should Promptly Address Critical Deficiencies in Process Safety Management: Process changes, replacement of antiquated equipment, preventative maintenance, adequate staffing, and other measures necessary for high reliability and excellence in process safety all require financial investments. While oil refiners, like BP, are reporting enormous, record-breaking profits, the U.S. Chemical Safety and Hazard Investigation Board (CSB) recently reported that cost-cutting “impaired” process safety performance in Texas City.[1] The refinery industry must use its vast wealth to take responsibility for preventing future horrors such as the BP Texas City catastrophe.

Thus, the findings of the USW Refinery Process Safety Survey document that critical process safety deficiencies are endemic within the industry and that many mirror those found at BP Texas City in March 2005. In order to prevent future similar incidents and to provide refinery workers, emergency responders, and surrounding communities with their rightful protection from harm, the USW asserts that the following actions are necessary.

The USW calls on the refining industry to initiate action immediately on the ten measures listed in the next section. These critical improvements will advance the pursuit of excellence in process safety management and protection of the nation’s workers, infrastructure and security. To be fully effective, it is necessary for refiners to engage workers and their local and international union representatives in developing and implementing these improvements.

Urgent and Critical Actions

1. **Establish a Process Safety Team as part of the Health and Safety Committee at each refinery**, including representatives selected by the local union, to plan, review, monitor, and audit all process safety activities.
2. **Ensure that process hazard analyses (PHAs) exist for all potentially hazardous operations and that those PHAs are reviewed and revalidated at least every**

three years. Working PHA teams must have the authority to ensure that all recommendations are prioritized and receive timely action.

3. **Address the four *highly hazardous conditions* associated with the March 23, 2005 BP Texas City disaster:**
   a. **Eliminate all atmospheric vents on process units** that could release untreated explosive, flammable, or toxic materials to the atmosphere.
   b. **Manage instrumentation and alarms** in a manner that ensures that they are sufficient and functional for all anticipated potential conditions and that there are no start-ups without tested and documented functioning of these systems.
   c. **Create a definition of "safe siting"** that when followed will ensure that refiners locate all trailers or other unprotected buildings in areas that could not expose occupants to harm from explosions, fires, or toxic exposures. Work in creating this definition is currently under way through the American Petroleum Institute.
   d. **Ensure that all non-essential personnel are outside of hazardous areas** (vulnerability zones), especially during start-ups, shutdowns, or other unstable operating conditions.
4. **Develop and implement policies requiring full safety reviews prior to all process start-ups and scheduled shutdowns.**
5. **Provide adequate staffing** to ensure safe operation in all potential normal and abnormal operating circumstances. Staffing must ensure that all members of the work force are able to carry out their work alertly and without adverse health effects.

Necessary Supporting Actions

6. **Provide effective, participatory worker training and drills** in the areas of: a) process safety management, b) emergency preparedness and response, and c) pre-start-up and shutdown safety reviews. Selection and presentation of training must be carried out in conjunction with the union using its nationally recognized model programs.
7. **Ensure that all operating manuals and procedures are in optimum working order**, that is, in writing, up-to-date, understandable, functional, available and properly used for the safe operation of all processes. The manuals and procedures must cover normal, abnormal, upset, and emergency operating conditions, shut-downs and start-ups.
8. **Review and update management of change (MOC) procedures** to ensure that they meet the recommendations of the U.S. Chemical Safety Board.
9. **Implement an effective incident and near miss investigation program at each site** that involves workers and their unions in all phases of investigation and recommendations for improvement. The USW's Triangle of Prevention (TOP) Program is a model in operation at 15 U.S. refineries and nine other petrochemical facilities. (See Appendix A, Description of the USW Triangle of Prevention (TOP) Initiative)

10. **Develop and implement a national set of standardized process safety metrics and benchmarks** to assess leading and lagging indicators of process safety. The CSB has requested that the National Academy of Sciences convene a panel to consider such metrics. Preliminary work is also being done under the auspices of the Center for Chemical Process Safety.

The USW asserts that these essential actions build on existing reports and will strengthen their recommendations.

The potential for management to join labor in identifying and acting to solve process safety problems is evidenced by a 2007 joint initiative between the United Steelworkers and BP. This initiative expresses a commitment “to ensure the safest possible conditions for BP employees and neighbors of BP facilities” and is “based in part on the findings and recommendations of the BP US Refineries Independent Safety Review Panel, the preliminary reports of the U.S. Chemical Safety and Hazard Investigation Board, BP’s own investigations, and the experience of the USW.” The initiative addresses the immediate causes of the Texas City tragedy, the formation of process safety teams, accident and near-miss investigation, review of safe operating procedures, health and safety education, staffing and reasonable work hours, operator leadership, maintenance, teamwork and environmental protection for corporate neighbors and additional measures as identified. (See Appendix B, USW BP Joint Initiative on Health and Safety)

Introduction

On March 23, 2005, a fiery blast at the BP refinery in Texas City, Texas killed 15 workers, injured 180 others and caused major alarm in the community. According to the U.S. Chemical Safety and Hazard Investigation Board (CSB), the incident led to financial losses exceeding $1.5 billion."[1] (p. 17) The incident resulted in over 300 citations for OSHA violations resulting in a record fine of $21 million.[2] The magnitude of this catastrophe marks it as one of the greatest failures of process safety management in U.S. history. It was also the biggest industrial disaster since passage of the Occupational Safety and Health Administration's (OSHA's) 1992 standard on Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119).

This study focuses on the large segment of the U.S. refinery industry where the United Steelworkers (USW) is the bargaining agent for hourly workers (71 out of the 149 U.S. refineries). USW-represented sites refine approximately 66% of the U.S. refining capacity. The research team surveyed local union leaders at these refineries to gather perceptual information on the prevalence within the U.S. refinery industry of highly hazardous conditions and practices related to the 2005 Texas City disaster and on other prevention, preparedness, and response issues.

Preliminary findings from investigations and reports on the March 23, 2005 BP Texas City fires and explosions suggest that four *highly hazardous conditions* were among the key factors related to the restarting of the isomerization (isom) unit after it had been shut down for repairs.[3,a] These key factors were substantiated by the CSB in its 2007 final report.[1]

The four key issues, hereinafter referred to in this report as *highly hazardous conditions*, are as follows:

1. **Use of Atmospheric Vents on Process Units:** The use of process venting, including an antiquated blow-down drum system,[4] released untreated flammable, explosive, and toxic liquids and gases directly to the atmosphere.

2. **Failed Management of Instrumentation and Alarm Systems**: Inadequate management of instrumentation and alarm systemallowed process indicators and alarms to malfunction and pro

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[a] Isomerization is a process that uses elevated temperatures and catalysts to rearrange molecules of crude distillation products to achieve higher octane. EPA. 1995. Profile of the Petroleum Refining Industry. Office of Compliance, Office of Enforcement and Compliance Assurance, U.S. Environmental Protection Agency, Washington, DC.

3. vided operators with faulty information on levels and product flows during the start-up of the isom unit.

4. **Siting Trailers Near Process Facilities**: The siting of trailers provided no protection to occupants near a processing unit and thereby exposed them to the release of toxic materials, fires, and explosions.

5. **Allowing Non-Essential Personnel in Vulnerable Areas During Start-Ups and Shutdowns**: The presence of non-essential personnel in close proximity to a hazardous processing unit during its start-up exposed them to the release of toxic materials, fires, and explosions.

In this report researchers address three key questions related to the March 23, 2005 BP Texas City disaster. The major focus of these questions is the *highly hazardous conditions* that contributed to the BP Texas City disaster. The key questions are:

A. To what extent do conditions similar to those that led to the BP Texas City catastrophe exist at the nation's other refineries, and what is being done to correct those conditions so that similar future disasters are prevented?

B. Are there regulations or guidelines that would, if applied, prevent or substantially mitigate such disasters?

C. Are there lessons that refiners should have learned from previous disasters that would have enabled them to eliminate conditions similar to those that led to the BP Texas City catastrophe?

The review of the literature below addresses the last two questions, which focus on existing regulations and guidelines and lessons from previous refinery disasters. Like BP Texas City, all U.S. refineries should have complied with these regulations and guidelines and learned and applied these lessons to protect workers, communities, and critical infrastructure.

,Chairman and Chief Executive Officer Carolyn Merritt of the U.S. Chemical Safety and Hazard Investigation Board (CSB) stated in her October 31, 2006 news conference:[5]

> Unfortunately, the weaknesses in design, equipment, programs, and safety investment that were identified in Texas City are not unique either to that refinery or to BP. Federal regulators and the industry itself should take prompt action to make sure that similar unsafe conditions do not exist elsewhere. (p.1)

Further, the blue ribbon BP U.S. Refineries Independent Safety Review Panel similarly noted:[6]

> While the panel made no findings about companies other than BP, the Panel is under no illusion that the deficiencies in process safety culture, management, or corporate oversight identified in the Panel's report are limited to BP. (p. 273)

The remainder of this report presents findings from the national study of USW-represented U.S. refineries. These findings answer the first question, above, about the extent to which the *highly hazardous conditions* exist at the nation's refineries and, thereby, threaten to contribute to future disasters similar to BP Texas City. This study further examines the extent to which the refining industry promptly acted to ensure that these conditions no longer existed elsewhere.

The participatory action research team that carried out this study was made up largely of members and leaders of the USW, primarily from the refining industry. Staff from the Tony Mazzocchi Center for Health, Safety and Environmental Education (TMC) and New Perspectives Consulting Group, Inc. led the team. The Tony Mazzocchi Center is a partnership between the USW and the Labor Institute.

Background

Refining: One of the Nation's Most Dangerous Industries

The U.S. Department of Labor (DOL) in reporting on the Phillips 66 catastrophe [7] identified refining as the petrochemical industry's most hazardous sector. Substantiating this claim, a U.S. Environmental Protection Agency (EPA) study of high volume chemical sites [8] found that refineries accounted for 10% of all chemical related accidents with nearly twice the number of any other industry.

Limited Adherence to Process Safety Guidelines and Regulations

The history of process safety management at high-hazard facilities prior to the March 2005 catastrophic accident at BP Texas City is marked by a trail of disasters.[9] Collectively, these disasters demonstrate the need for effective systems for chemical accident prevention. Aiming at disaster prevention, both governmental and non-governmental organizations established detailed regulations and guidelines. These have included:

- OSHA's standards on Hazardous Waste Operation and Emergency Response[10] and Process Safety Management of Highly Hazardous Chemicals,[11] and
- EPA's Risk Management Program[12]
- Numerous guidelines from national and international bodies and professional and industry-based organizations[13]

Together, these regulations and guidelines provide every refiner with mandates and directions necessary for effective process safety systems if refiners choose to comply.

In spite of this guidance, Rosenthal and others[14] have contended that, "the less than expected decrease in accident incidence has occurred because the newly adopted regulations have not resulted in the hoped for adoption of 'effective' process safety management systems by industry." (p. 136)

Lessons Left Unlearned

In the CSB's October 27, 2005 news release,[15] it noted that lessons from previous BP Texas City incidents would have helped correct flawed systems prior to the March 23, 2005 disaster had the company applied this knowledge. In an Organisation for Economic Cooperation and Development (OECD) report,[16] Rosenthal noted the importance of the concept of "lessons learned" by stating:

> While important lessons are constantly being learned, … it is clear that implementation of lessons already learned could have prevented the large majority of process accidents.
>
> Inadequately designed and/or executed Process Management Systems are the 'root cause' of the failure to effectively use lessons learned. (p. 12)

Rosenthal is describing dysfunctional organizational learning[17] related to process safety incidents. According to Argyris and Schön:[18]

> Organizational inquiry, consisting in actively constructing and sorting out puzzles generated in the process of probing, is essential to the firm's strategic conversation with its environment and central to fostering of strategic learning. (p. 259)

This type of strategic organizational learning is necessary if companies are to find solutions that truly solve underlying problems rather than those that are most convenient and acceptable to current ways of operating.

Marais and her co-authors[19] state:

> Safety goals often do not coincide with performance goals … and in fact often they conflict. In addition, while organizations often verbalize consensus about safety goals …, performance and decision making often departs from these public pronouncements. (pp 5-6)

Two sets of lessons critical for effective process safety have been available to U.S. refineries for organizational learning: 1) lessons that refineries should have learned and applied prior to the March 23, 2005 disaster at BP Texas City, and 2) lessons these organizations should have learned from that disaster and applied since. As early as October 2005, the U.S. CSB noted that its preliminary findings from the BP Texas City incident should be reviewed throughout the industry with the goal of achieving safer operations.[15]

In examining lessons available for learning prior to the Texas City disaster, a long list of petrochemical facility events has relevance. The following sections describe how these incidents relate directly to conditions contributing to the issues examined in the USW refinery survey.

Uncontrolled Atmospheric Release of Hazardous Materials

The 1989 Phillips 66 explosion;[7] the 1997 Shell Deer Park refinery disaster;[20] and the BP, 2000 Grangemouth (Scotland) incident [21] all involved the release of flammable or explosive process materials to the atmosphere. The massive Phillips explosions resulted from ignition of a release of polyethylene process gases during reactor maintenance and subsequent explosions of two isobutane storage tanks and a polyethylene reactor.[7] In the Shell disaster, a faulty check valve released flammable gases that resulted in an unconfined vapor cloud explosion.[20] The Grangemouth incident involved a significant leak of hydrocarbons from the Fluidized Catalytic Cracker Unit (FCCU or Cat Cracker) during start up procedures. A resulting vapor cloud ignited causing a serious fire.[21]

Following each of these incidents investigators made a number of recommendations directly relevant to the prevention of vapor cloud releases like those involved in the BP Texas City disaster. Included among these was the need for more thorough process hazard analyses (PHAs).[22]

Failing Instrumentation and Alarm Systems

Past petrochemical plant incidents have also made available important lessons related to instrumentation and alarm failures. The 1997 Tosco Avon Refinery explosion and fire; [23] the disaster at Equilon, Anacortes in 1998; [24] and a 2000 incident at BP Grangemouth provided examples of instrumentation and alarm failures that resulted in faulty readings, stop-gap control measures, and critical control decisions with limited information. Findings from reports on each of these incidents led to the dissemination of recommendations that were directly pertinent to the BP Texas City disaster.[25, 26, 27]

Unsafe Siting of Trailers and Unprotected Buildings

Siting issues related to the proximity of highly hazardous processes to the onsite work force was tragically evidenced at BP Texas City. Years before, the DOL reported on the Phillips 66 disaster [7] and addressed these same issues. Also directly related were the disasters at the Pennzoil Refinery (1995) [28] and the Tosco Avon Refinery (1997).[23] In the Pennzoil incident, EPA stated that:

> Equipment siting and containment was inadequate…. In addition, tool and work break trailers were spotted within a general containment area near the tanks. These trailers were destroyed by the liquid and fire. (p. iii)

In its report on the 1997 Tosco incident, the EPA[23] documented the following:

> Some of the injured were inside or near contractor trailers close to the Hydrocracker Unit. The blast from the explosion blew out the windows of one trailer and the flames prevented workers from exiting the trailer door. The workers climbed out of the trailer window facing away from the fire…. Some workers who were knocked down were in a tent receiving a safety orienta

> tion. Other personnel fell or tripped as they tried to run away from the explosion and fireball. (p. 22)

The Tosco and Pennzoil reports made siting recommendations directly applicable to the BP Texas City accident[29, 30] In addition, following that accident, the CSB called on the American Petroleum Institute (API) to update and improve its guidance for trailer siting at refineries and called on the National Petrochemical and Refiners Association (NPRA) to "immediately contact their members urging prompt action to ensure the safe placement of occupied trailers away from hazardous areas of process plants." (p. 2)[31]

Non-Essential Personnel in Hazardous Areas

The descriptions of the lessons learned related to the disasters at Phillips 66,[7] Pennzoil,[28] and Tosco[23] bear witness to the importance of limiting access in highly hazardous areas to only those persons who must be present. As noted in the EPA Tosco report, process hazard analyses (PHAs), if properly performed, should dictate the need to limit access of non-essential personnel. PHAs are hazard evaluations used in process safety involving a variety of specialized diagnostic methods.

Additional Process Systems Failures

The reports of these refinery disasters detail numerous other failures related to the 16 process safety systems examined in the USW survey. In the case of Phillips 66[7] DOL reported:

> Other failures involved were: safe operating procedures, permit systems, gas detection and alarm systems, control of ignition sources, ventilation system intakes for close proximity occupied buildings, and the fire protection system. (pp. 25-26)

DOL's statement regarding ventilation system intakes is especially important in relation to "blast resistant modules" being used at refineries. The modules are designed to resist outside explosions, but not the infiltration of toxic, flammable or explosive gases or vapors.

In the Phillips 66 case, OSHA also noted:

> Findings in the investigation of the Phillips Complex disaster support the conclusion that poor risk assessment and management, lack of redundant systems and fail-safe engineering, inadequate maintenance of equipment, poorly conceived operational or maintenance procedures, and incomplete employee training are the underlying factors that contribute to or heighten the consequences of an accident. (p. 62)

Although training alone cannot compensate for other inadequacies, high quality training that actively engages employees can act as a stimulus for critical assessment and action. This is noted by the United States Fire Association (USFA) in conjunction with the Department of Homeland Security (DHS) in its guidelines on process safety management training.[32] The importance of chemical disaster prevention training is further reinforced by the National Institute of Environmental Health Sciences (NIEHS) Worker Health and Safety Training Program (WETP).[33]

Following the Phillips 66 disaster, OSHA commissioned the John Gray Institute study on issues surrounding the extensive use of contract workers in the petrochemical industry. The Institute's report[34] suggested an increasing trend in the use of contractor workers with consequences evident in the report's human resource profile:

> Compared to the sample of direct-hire workers, contract workers are, on average, younger and less educated. The case studies also found that contract workers are more likely to have English language or communications difficulties. Contract workers also receive less safety training than direct-hire workers, are less likely to be unionized or covered by a labor-management safety and health committee, and less likely to participate in safety discussions with others on their site. (p. xvi)

In summary, there is a long and enduring pattern of companies within the refining industry choosing to ignore the lessons available for learning and willing to risk catastrophe rather than investing in the systems critical to keeping workers, communities, the environment, and company assets safe

Methods

Following the March 2005 BP disaster, the Mazzocchi Center conducted a survey of U.S. refineries where the USW represents workers. The survey sought to find out about conditions, processes, practices, and actions relevant to prevention, preparedness, and response to possible future incidents involving fires, explosions, or large releases of highly hazardous chemicals. More specifically, the 64-item, mail-back survey instrument asked about the following issues:

- Four targeted *highly hazardous conditions*, their prevalence, and company actions to correct them
- Emergency preparedness and response
- Process safety-related training
- Contract and company workers' preparedness to help prevent incidents
- Ratings of 16 process safety systems for start-ups and shutdowns, and
- Overall ratings of process safety systems.

The study used a participatory research methodology. [35, 36, 37] The participatory research team included:

- USW rank and file workers, primarily those employed at oil refineries
- USW Health, Safety and Environment Department staff
- USW International Union leadership including a vice president
- Education and evaluation consultants from New Perspectives Consulting Group and the Labor Institute.

(See Appendix C to view the USW Survey on Refinery Accident Prevention)

A subgroup of the participatory research team designed the survey instrument. After completion of data entry, cleaning, and tabulations, the team analyzed the resulting data and generated a preliminary report at an in-person working meeting. Follow-up consultations with the team were conducted via phone and email, including team review of report drafts for further comment. Members of the team reviewed this final report prior to its release.

In selecting sites to survey, the USW developed a target list of oil refinery sites based on the North American Industrial Classification System (NAICS) code 32411 and a listing of USW local unions/company sites. In January 2006, nine months following the Texas City disaster, researchers sent a packet of information to the local union presidents and recording secretaries at each of the 71 USW-represented refineries. The survey packet included a cover letter, a survey factsheet, an instruction sheet, and a mail-back oil refinery survey (one survey per site). Instructions asked the USW local union leadership to engage persons from the local union who were knowledgeable about refinery health and safety in completing the survey.

Researchers conducted follow-up by mail, email, and telephone to achieve a response rate of 72% (51 of 71 refinery sites). The responding local unions were from refineries in 19 U.S. states and one territory. (See Figure 1.)

Figure 1. U.S. States/Territories and Number of Refinery Sites Responding to Survey

State	No. Sites	State	No. Sites	State	No. Sites
AL	1	KS	1	OK	1
CA	8	KY	2	PA	1
CO	1	LA	5	TX	10
DE	1	MN	1	UT	4
HI	1	MT	4	VI	1
IL	1	ND	1	WA	2
IN	1	OH	4		

Twenty-two (22) refining companies operated the refineries at these sites. (See Figure 2.)

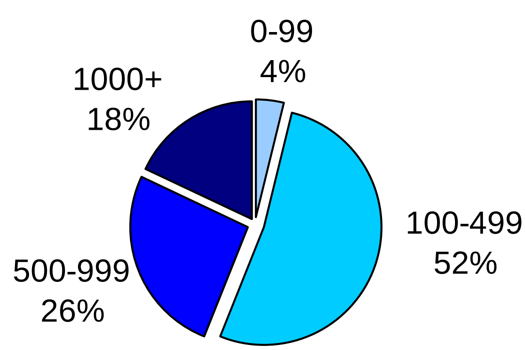
Figure 2. Refinery Companies Operating Survey Sites

BP	Flying J	Murphy Oil
CHS Coop	Frontier	Shell-Motiva
Chevron	Holly	Suncor
Citgo	Hovensa	Sunoco
Conoco-Phillips	Lyondell-Citgo*	Tesoro
Delek Refining	Marathon-Ashland	Total
ExxonMobil	Montana Refining	Valero
Flint Hills		

* Changed to Lyondell Houston Refining since survey

The size of the work force at the 51 responding refineries was predominantly mid-sized, that is, between 100 and 499 persons. (See Figure 3.)

Figure 3. Size of Workforce at USW Refinery Sites Responding to Survey



51 responses, 2% missing

In terms of the U.S. refining industry, the 51 responding sites represented 34% of the United States' 149 refineries. Further, these sites represented 49% of the U.S. refining capacity (8.7 million of the 17.8 million barrels per day).[38]

Results of the Survey

Pervasiveness of *Highly Hazardous Conditions* Similar to Those Found at BP Texas City

Investigators of the BP Texas City incident documented four *highly hazardous conditions* that contributed to that March 2005 catastrophe. These conditions included: 1) use of atmospheric vents on process units, 2) failed management of instrumentation and alarm systems, 3) siting of trailers and unprotected buildings near process facilities, and 4) allowing non-essential personnel in vulnerable areas during start-up and shutdown.[39] This survey explores all four of these *highly hazardous conditions*.

This sub-section focuses primarily on the three conditions that lend themselves well to survey measurement: atmospheric vents on process units, trailers and unprotected buildings near process facilities, and non-essential personnel in vulnerable areas during start-up and shutdown. Data about failed management of instrumentation and alarm systems findings are included in subsequent sub-sections.

When researchers examined the presence of these three *highly hazardous conditions* collectively, sites reported:

90% - had one or more *highly hazardous conditions* (46 of 51)

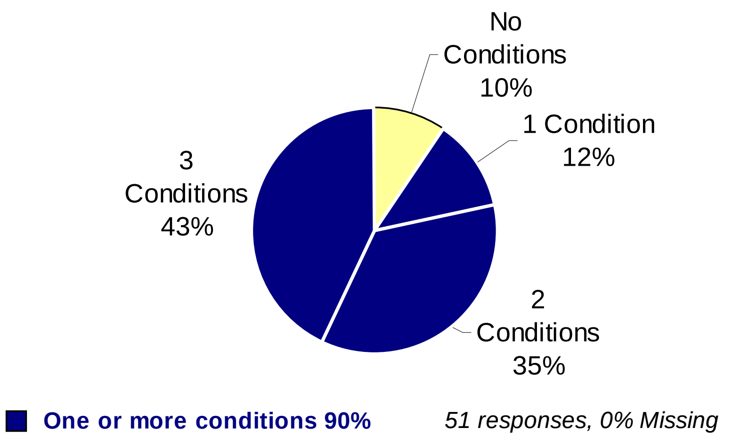
12% - had one

35% - had two

43% - had all three

(See Figure 4.)

Figure 4. Prevalence of *Highly Hazardous Conditions* at Refineries



The presence of the specific *highly hazardous conditions* among sites was as follows:

66% - had atmospheric vents on process units (33 of 50).

78% - placed trailers or other unprotected buildings in hazardous areas in the last 3 years (40 of 51).

70% - had non-essential personnel present in vulnerable areas during start-ups and shutdowns in the last 3 years (35 of 50)

A Closer Look by Highly Hazardous Conditions

Atmospheric Vents on Process Units: The following list presents the number of atmospheric vents on process units among the 33 sites reporting such vents:

58% - had 1-10 atmospheric vents

15% - had 11-30 atmospheric vents

27% - had 31 or more atmospheric vents

Respondents reported the presence of atmospheric vents on a wide range of process units.[40] Though not asked specifically about blow-down drums or stacks, 16 percent of respondents (5 of 33) that had reported the presence of atmospheric vents used open-ended questions to report that atmospherically vented blow-down drums were in use at their sites. There may have been more blow-down drums than those reported. An atmospherically vented blow-down drum was a key component of the process failures at the BP Texas City facility during the 2005 catastrophe.

Trailers and Other Unprotected Buildings: Over three-quarters (78%) of respondents (40 of 51) reported trailers or other unprotected buildings inside potentially hazardous areas in the last three years. Slightly fewer, 69% (35 of 51) reported that their company had formal written policies prohibiting the siting of trailers or other unprotected buildings in these areas (20% reported *no* policies and 12% *don't know*). The data neither indicated when these policies were established nor their content. Thus, these refinery policies may have been developed after the Texas City catastrophe, refineries may have been violating their own policies, and/or refinery policies may have permitted such siting.

The 40 sites that reported trailers or unprotected buildings in hazardous areas also reported the following numbers of these structures:

89% - 1-50 trailers or unprotected buildings

11% - 51 or more

Respondents reported trailers and other unprotected buildings were located near a wide variety of processing units, provided descriptions of locations, and described potential hazards.[41]

Non-Essential Personnel: Seventy percent (70%) of respondents (35 of 50) reported their sites engaged in process start-ups or shutdowns with non-essential personnel in vulnerable areas in the past three years (22% reported *no,* and 8% *don't know*). Fifty-four percent (54%) of respondents (27 of 50) reported the existence of formal written policies regarding the presence of non-essential personnel in areas vulnerable to a toxic or hazardous materials release, fire, or explosion during start-ups or shutdowns (26% reported *no* written policies, 20% *don't know*). The data neither indicated when these policies were established nor their content. Thus, these refinery policies may have been developed after the Texas City catastrophe, refineries may have been violating their own policies, and/or refinery policies may have permitted non-essential personnel in hazardous areas during start-up and shutdowns.

Reported Incidents or Near Misses

In addition to the presence of *highly hazardous conditions*, a large number of sites reported that there had been incidents or near misses connected to these conditions in the past three years:

61% - reported one or more incidents or near misses involving at least one *highly hazardous condition*

39% - reported no incidents or near misses for these conditions

The following details more specifically the percentage of sites experiencing one or more incidents or near misses involving one or more of the four *highly hazardous conditions*:

10% - one or more incidents or near misses involving all four *highly hazardous conditions*

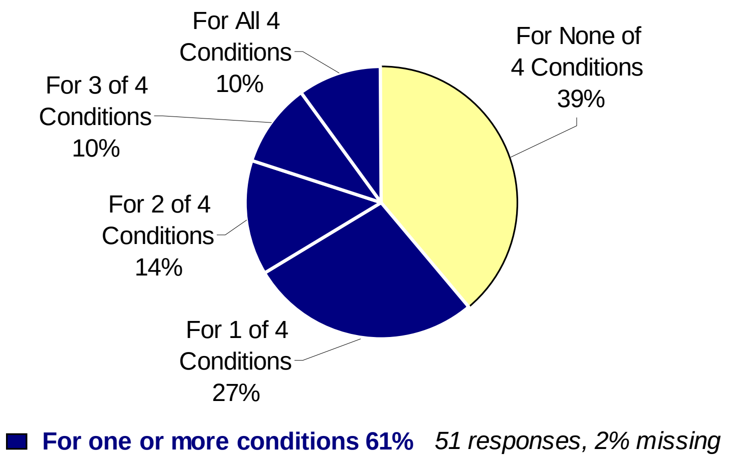
10% - involving three *highly hazardous conditions*

14% - involving two *highly hazardous conditions*

27% - involving one *highly hazardous condition*

(See Figure 5.)

Figure 5. Reports of Incidents or Near Misses at Refineries Related to the Four *Highly Hazardous Conditions*



Incident or near miss figures related to the four *highly hazardous conditions* may be higher than reported here because a range of 18-31% of respondents reported *don't know*.

Examination of only those sites where *highly hazardous conditions* existed, with separate analyses for each of the four conditions, shows that between approximately one-third and one-half of respondents reported incidents or near misses involving those conditions as follows:

48% - incidents or near misses involving atmospheric vents on process units (16 of 33)

43% - involving management of instrumentation and alarm systems (21 of 49)

30% - involving trailers and other unprotected buildings near process units (12 of 40)

41% - involving non-essential personnel in hazardous areas during start-up or shutdown (14 of 34)

Descriptions of Incidents and Near Misses

The 31 sites reporting incidents or near misses involving one or more of the *highly hazardous conditions* provided descriptions of those events. Examples of the range of incident or near miss descriptions follow. Each description is from a different refinery.

- *[The] reformate level in [the] tower was at high levels during start-up. Operations management intentionally raised levels, which did not allow operations personnel to know where the levels were. This caused a release of reformate into other ar*

- *eas of [the] refinery. Non-essential personnel were in areas exposed to hazards….*
- *Multiple units upset several PSVs [Process Safety Valves] that go to [the] atmosphere [and they] lifted. [About] 40 people [were] at [the] refinery at [the] start of [the] event [and] 82,000 pounds of hydrocarbon [were] released to [the] atmosphere.*
- *Acid leak involved approximately 10+ people, most of whom were non-essential personnel. No injuries [occurred] but the potential for [a] disaster or a catastrophic event was there.*

The description that follows illustrates a problem with atmospheric vents on process units:

- *Isom [isomerization] flame radiant heat near coker… hydro cracker flame allowed liquid to flame tip. That caused fire at base.*

Respondents reported examples of failed management of instrumentation and alarm systems, such as:

- *A seal pot level indicator failure causing [a] liquefied petroleum gas [LPG] release and fire…. It was later discovered that the seal pot … was empty and [the] mechanical seal was leaking LPG - causing the fire…. Instruments were giving false readings [that were] nearly overlooked.*
- *Instruments were accurate but management wanted to ignore alarms. Union operators and front line supervisors refused to proceed and [insisted that we] find [the] problem.*
- *[We] always have near misses with instrumentation. [We] had a boiler failure with hydrogen sulfide release to [the] atmosphere with [a] contractor working in [a] process unit next to [the] release. [There were] no injuries. [The] contractors [were] instructed to evacuate to their safe area and work [was] stopped!*

Respondents reported examples of near misses and actual incidents during start-ups and shutdowns that involved trailers and unprotected buildings and non-essential personnel in vulnerable areas:

- *[There was an] explosion and fire in [a] process unit. [It] caused damage to a trailer roughly 30 feet to 40 feet away. [There were] no injuries. There have been issues with instrumentation that has failed or been inhibited.*
- *Trailers for t[urn]a[round are] set-up before units are shutdown and cleared of hydrocarbons. Non-essential personnel [are] allowed all over the unit while the unit is being shut down and started-up.*

- *[Our site] allowed non-essential personnel (approximately 200 contractors) in hazardous areas during shutdown and start-up. [The following units and hazardous materials were involved:] FCC [fluidized catalytic cracking unit], alky propane, butane, acid, caustic, gas oils, ammonia and hydrogen sulfide.*

One of the incidents reported was strikingly similar to the Texas City disaster, including the involvement of a blow-down drum. The respondent reported:

- *[During the] cat[alytic] cracker start-up we had their blow-down tower over-run. [It] caused a vapor cloud, [but there was] no ignition source.*

Company Actions

The survey solicited answers from all respondents about company actions to ensure that instrumentation and alarms functioned properly following the March 2005 BP Texas City catastrophe. In addition, for those sites where respondents indicated the presence of the remaining three *highly hazardous conditions,* the survey solicited responses regarding company actions to address these conditions. As highlighted below, "actions" ranged from audits to actual changes in conditions. Respondents reported the companies at their sites acted to:

32% - replace atmospheric vents on process units with safer venting systems.[a]

52% - ensure that instrumentation and alarms function properly.[b]

88% - move trailers or other unprotected buildings outside of potentially hazardous areas.[a]

46% - ensure that all non-essential personnel are at a safe distance during a process start-up or shutdown.[a]

As highlighted below, these actions were reportedly of varied effectiveness in correcting the problems at hand.

Effectiveness of Company Actions: The respondents who reported that their companies took action to address the *highly hazardous conditions* were then asked to rate their perceptions regarding the effectiveness of these actions.

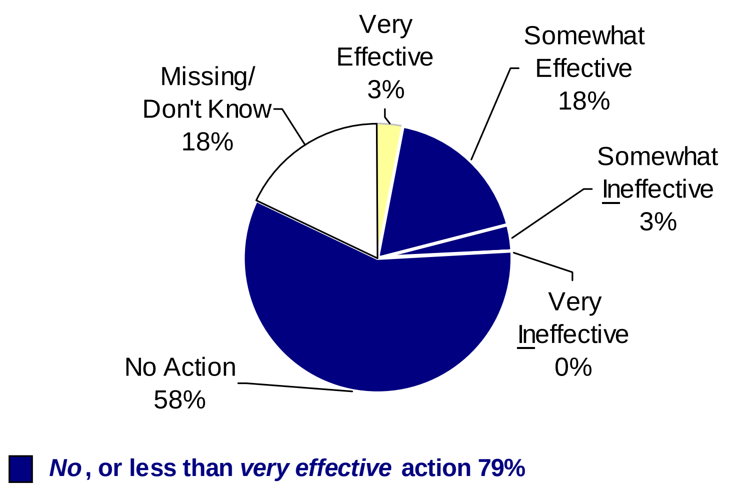
To present a more complete picture of company action and inaction concerning the four *highly hazardous conditions,* researchers combined data from two different groups of questions. These included the data regarding company actions to address the *highly hazard*

[a] Analysis includes only those sites where respondents reported the presence of the *highly hazardous condition*.
[b] Analysis includes all sites.

ous conditions (*yes, no, don't know*), and the data on the level of effectiveness of those actions (*very effective action*, *somewhat effective action*, *somewhat ineffective action*, *very ineffective action*). The combined categories include *no action, don't know,*[a] and all of the effectiveness ratings about the actions. Accordingly, all responses in this subsection include only those sites at which the respondents reported the presence of the four targeted *highly hazardous conditions*.

Assuming that the four *highly hazardous conditions* require *very effective action*, the dark shading is used in the charts below, and throughout this report, to indicate data in the categories of *no action* and less than *very effective* action. In summary, 59-79% of respondents indicated that either no action or less than *very effective action* was taken related to each of the conditions, with an additional 5-24% of respondents falling in the *don't know* or missing categories. (See Figures 6-9.)

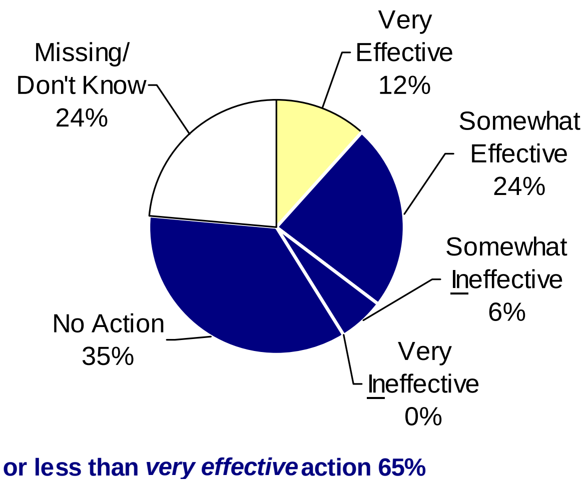
Figure 6. Replacing Atmospheric Vents: Action and Effectiveness



33 responses - limited to sites reporting atmoshpheric vents

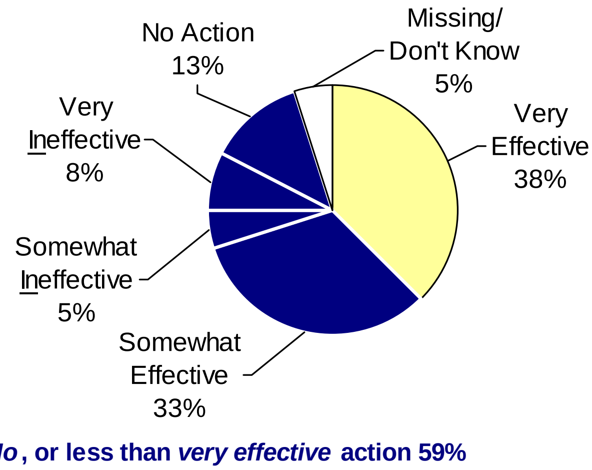
[a] Charts on these questions combine *don't know* with *missing* responses.

Figure 7. Managing Instrumentation and Alarms: Action and Effectiveness



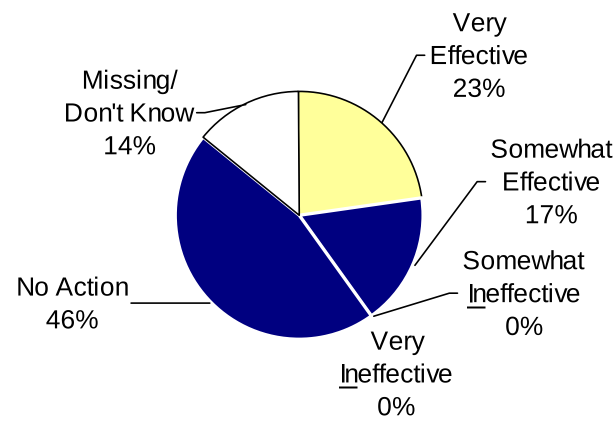
51 responses

Figure 8. Removing Trailers and Other Unprotected Buildings: Action and Effectiveness



40 responses - limited to sites reporting trailers/unprotected bldgs.

Figure 9. Keeping Non-essential Personnel Out of Hazardous Areas: Action and Effectiveness



***No*, or less than *very effective* action 63%**

35 responses - limited to sites reporting non-essential personnel in hazard. areas

Descriptions of Company Actions: Respondents from the 31 sites with atmospheric vents on process units reported three primary types of actions by the companies at their sites to replace those vents with safer ones, as follows:

- Acted to make changes
  - *[There] has been a concerted effort to tie all pump vents directly into flare system. [In addition] as situations arise and exchangers come out of service and vents are discovered, they are being plugged off.*
- Reviewed audits or risk assessments:
  - *Company has contacted engineering firms to study refinery needs….*
  - *Currently [they are] conduct[ing] risk assessment of the crude unit to evaluate if it is possible to put it to a close[d] system.*
  - *There was an audit to identify all hydrocarbons releasing to the atmosphere.*
- Changes underway or in process
  - *Capital projects to revise piping to [one] flare, [and] two more to be completed in 2006 … they [the company] are working to migrate. [The union leaders] do not know thetime frame for resolutions….*

- *Have started updating the flare system and tying atmospheric vents to the flare system.*
- *[The company has] … removed … [and] blinded off [a number of these vents].*

Overwhelmingly, in the area of management of instrumentation and alarms for start-ups and shutdowns, respondents described routine actions that did not indicate new actions or policies. In a number of cases respondents wrote that, "actions are not based on March 23, 2005" and then proceeded to describe routine company practices. However, some respondents reported actions that were intended to address instrumentation after the Texas City disaster. These actions included:

- *Increased preventive maintenance work on instrumentation, improved response on work orders, and improved program to input test and repair instrumentation.*
- *Developed critical safety device policy and it is now under review. Developing area electrical classification drawings for each process area, and [are] generating loop drawings for process instrumentation....*

A notable number of respondents reported that the company at their site had taken some actions to move trailers or other unprotected buildings outside potentially hazardous areas or had developed or revised policies or procedures regarding trailer siting, for example:

Company moved trailers several months later, after making a new parking lot that would hold the trailers.

- *They moved all of them (trailers) to a central location out of blast zones.*
- *Developing written policy to ensure trailers are greater than [a certain number of] feet from process units.*

There were frequent reports of no action at all, the presence of other unprotected buildings, not completing trailer removal, and the introduction and use of blast/explosion resistant trailers, for example:

- *[While] all trailers have been moved away from process units, blast zones still have unprotected buildings, [or] offices inside process units [which are in the] blast zones.*
- *Relocated most contractors to a safer location, [but] did not move some of the trailers and storage buildings used by employees.*

- *The company has purchased "blast resistant" trailers with no windows.*
- *Developed plans for installing "blast resistant modules" for operator shelters and turn-around trailers.*

Finally, regarding company action addressing non-essential personnel in vulnerable areas, respondents reported that many employers reviewed, revised, or developed policies limiting access of non-essential personnel in hazardous areas, for example:

- *[Have a] procedure in place to minimize non-essential personnel and also better communication and planning to alert employees to start-up and shutdown times and schedules.*
- *Company's using improved communication during start-up and shutdown including posters and taping off an area.*

Training Received: The survey asked respondents about the percentage of the work force the company had trained about the four *highly hazardous conditions* since the March 2005 BP explosion. Only those sites where respondents reported the presence of the *highly hazardous condition* are included in this analysis. Researchers assumed that it would be at these sites that the training would be most needed and relevant. For ease of reporting, researchers created four categories: 1) 0% of the work force trained, 2) 1 to 50% of the work force trained, 3) 51 to 100% of the work force trained, and 4) don't know.

A range of 30 to 42% of sites reported no training of the work force depending on the *highly hazardous condition.* Almost as many sites reported *don't know*, with a range of 21 to 42%. Where companies did conduct training on these conditions, 12 to 16% of sites trained half or less of the work force and 3 to 26% of sites trained more than half. The area of least training was atmospheric vents on process units (15% of sites conducted any training).

In open-ended replies respondents described the training approaches and target audiences on which companies focused regarding preventing catastrophic events involving the four *highly hazardous conditions*. Training approaches included computer based training and testing, emails, tailgate and safety meetings, and meetings prior to start-ups and shutdowns. Few described classroom-based health and safety training. In addition respondent comments suggested that managers had received more training than hourly workers. The following comments illustrate:

- *The company has used computer based-training and testing to educate operators about instrumentation that is critical to [the] operation.*

- *Emails have been sent and procedures discussed before unit shutdown.*
- *Operator to operator training.*
- *[There was a] discussion between first line supervisor[s] … and operations personnel. [They] referenced [the] Health Safety and Environment training manual, [but there] were no handouts, just [an] oral presentation for [the] location of temporary buildings.*
- *[A] small percent of operations folks have been involved in safety meetings that contained the above topics. Formal training since 3/23/05 [the date of the BP catastrophe] has not happened.*
- *The management group was trained about vent problems and trailer siting.*

Need for Additional Training: Again, only those sites where respondents reported the presence of the *highly hazardous condition* are included in this analysis. Researchers assumed that it would be at these sites that the training would be most needed and relevant. More than half of the respondents reported that workers at their sites needed additional training about each of the four *highly hazardous conditions* targeted in this survey. The reports of sites needing training on *highly hazardous* conditions included:

81% - on atmospheric vents on process units

57% - on instrumentation and alarms systems

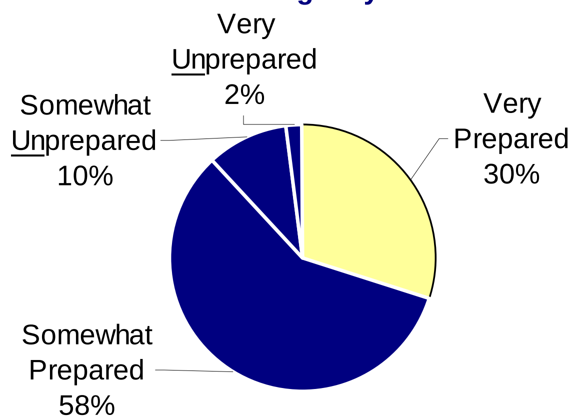
62% - on trailers or other unprotected buildings

88% - on non-essential personnel in hazardous areas

Emergency Prevention, Preparedness and Response

Respondents were asked how well prepared their worksites were to respond safely to a serious hazardous materials incident or emergency. Less than one-third (30%) reported that their sites were *very prepared.* In other words, 70% of respondents said their worksite was <u>less than</u> *very prepared.* Assuming that the hazardous conditions at refineries require the work force to be *very prepared* to respond to incidents, the dark shading on the charts below indicates data in the categories of <u>less than</u> *very prepared*. (See Figure 10.)

Figure 10. Overall Worksite Preparedness to Respond to a Hazardous Materials Incident or Emergency



Less than *very prepared* 70% *48 Responses, 6% missing*

Actions to Improve Emergency Preparedness and Response: Those surveyed were asked if the company had taken action since the BP Texas City disaster to improve emergency preparedness and response. Respondents reported company actions to improve emergency preparedness and response as follows:

46% - had taken action

38% - had not taken action

16% - don't know

For the 23 sites where company action was reported, respondents described: 1) upgrading equipment that could support an emergency response including fire trucks and alarms, 2) improving emergency response training for the fire brigade and, in some cases, for other employees, and 3) holding drills. The 23 sites also rated the effectiveness of their company's actions to improve emergency preparedness and response as follows:

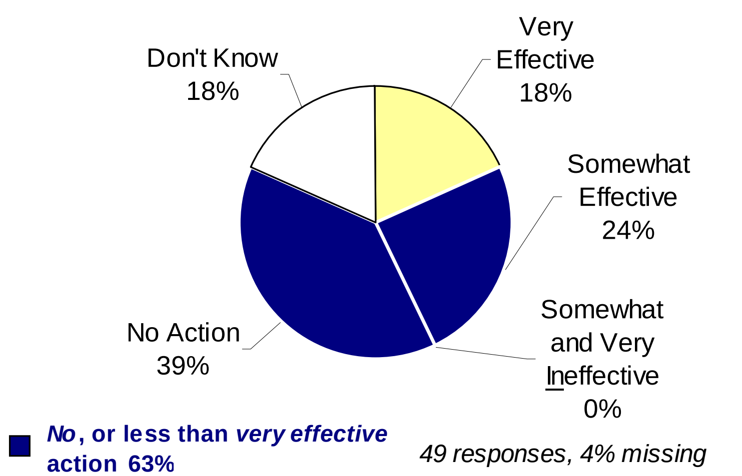
41% - action taken was *very effective*

55% - action taken was *somewhat effective*

5% - don't know

To present a more complete picture of company action as well as inaction concerning the improvements of emergency preparedness and response, researchers, again, combined data from two different groups of questions. These included the data on whether the company acted to improve emergency preparedness (*yes, no, don't know*) and the data on the level of effectiveness of company actions (*very effective action*, *somewhat effective action*, *somewhat* *ineffective action*, *very ineffective action*). The combined categories include *no action* and *don't know,* and all of the effectiveness ratings about the actions. (See Figure 11.)

Figure 11. Company Acted to Improve Emergency Preparedness & Response



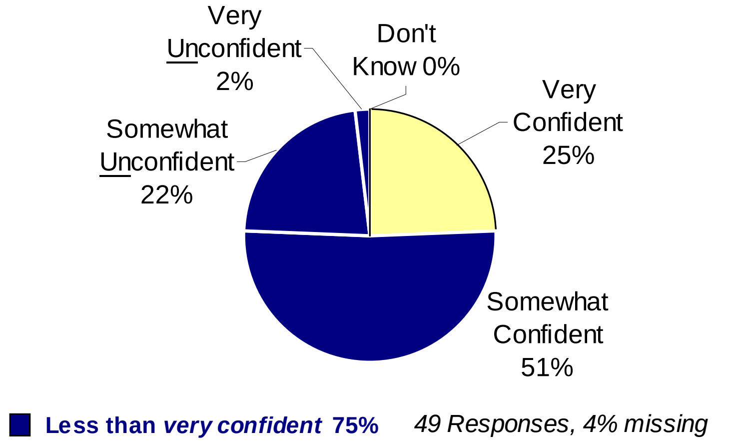
Emergency Response Training Recipients*:* The survey asked respondents about which groups of workers had received emergency response training in the last 12 months. Respondents reported the following:

96% - emergency response team, hazmat team, or fire brigade at the site had received training

77% - general plant population at the site had received training

Confidence in Training: The survey sought to learn how confident respondents were that the work force had received the training it needed to respond safely to a serious hazardous materials incident or emergency. While one-quarter said they were *very confident,* three-quarters stated that they were less than *very confident* (*somewhat confident, somewhat and very unconfident*). (See Figure 12.)

Figure 12. Confidence Workforce Has Received Training It Needs to Respond Safely to a Serious Hazardous Materials Incident or Emergency



Company and Contractor Preparedness to Help Prevent Hazardous Materials Incidents

When describing how prepared routine maintenance and turnaround or overhaul workers were to help prevent hazardous materials incidents, notable differences emerged when comparing contract and company workers. Overall, respondents reported that company workers were much better prepared than contract workers to help prevent hazardous materials incidents. For contract workers, 94% of responding sites reported that routine maintenance workers were less than *very prepared* (6% *very prepared*). Similarly, for turnaround/overhaul contract workers, 100% of responding sites reported these workers were less than *very prepared* (0% *very prepared*). In contrast, approximately one-third (31% and 32%) rated company maintenance workers *very prepared* for the same two types of work.

Company and Union Initiatives to Work On Issues Covered In Survey

Researchers asked whether the union and/or the company had undertaken initiatives to improve policies, training, procedures, or conditions related to the four *highly hazardous conditions* targeted in the USW survey since the March 23, 2005 BP Texas City refinery explosion. Respondents reported the following types of initiatives:

30% - BOTH union and company initiative[42]

34% - local union initiative ONLY

6% - company initiative ONLY

30% - NO INITIATIVE by either union or company

Process Safety Management

Respondents rated 16 systems related to process start-ups and shutdowns. (See Figure 13.)

Figure 13. Process Safety Systems Rated for Start-Ups and Shut-downs

1. Design and Engineering	2. Monitoring and Measurement Systems
3. Work Organization and Staffing Levels	4. Alarm and Notification Systems
5. Managing the Change of Systems	6. Process Hazard Analyses (PHAs)
7. Inspection and Testing	8. Operating Manuals and Procedures
9. Relief and Check Valve Systems	10. Training
11. Systems for Containing Hazardous Materials	12. Emergency Preparedness and Response
13. Emergency Shutdown and Isolation Systems	14. Communication Systems within the Plant
15. Fire and Chemical Suppression Systems	16. Communication Systems for Outside the Plant

For only one of the 16 process safety systems examined — *emergency preparedness and response* — did more than one-third (34%) of respondents rate the system as *very effective*. Even for this system, 64% of respondents rated it as less than *very effective* for start-ups and shutdowns. For 10 of the 16 systems, more than three-quarters of respondents rated them less than *very effective*. For example, for training, 90% rated this system as less than *very effective*. (See figure 14 below).

Other systems for which more than three-quarters of respondents rated the system as less than *very effective* for start-ups and shutdowns included:

88% - Work organization and staffing

86% - Design and engineering of systems

81% - Managing the change of systems (MOC)

78% - Emergency shutdown and isolation systems

- Alarm and notification systems

- Process hazard analysis (PHA)

76% - Communication systems within the plant
- Monitoring and measurement systems
- Systems for containing hazardous materials

(See figures 15 to 23 below.)

Figure 14. Effectiveness of Training for Start-ups and Shut-downs

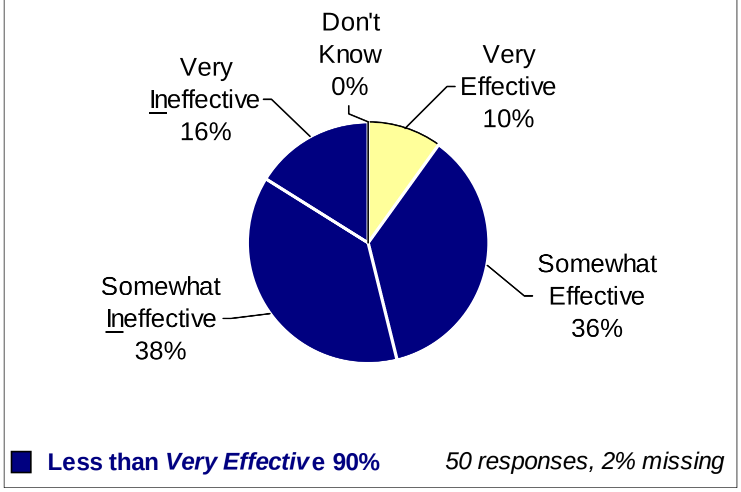


Figure 15. Effectiveness of Work Organization and Staffing Levels for Start-ups and Shut-downs

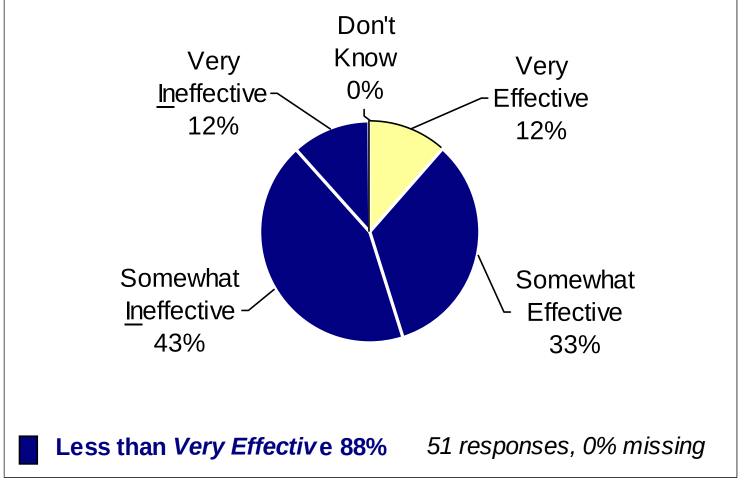
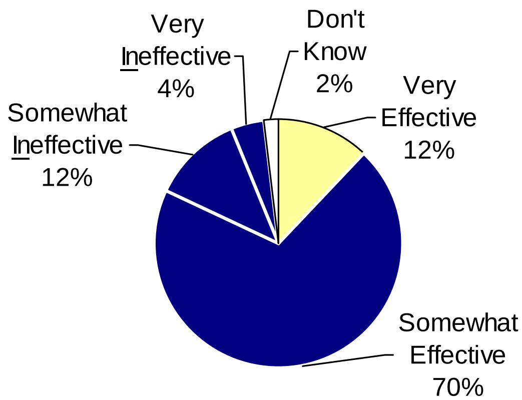
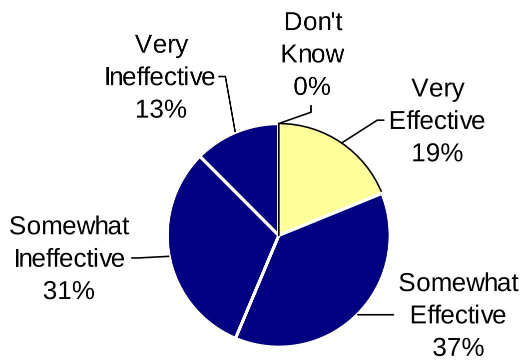


Figure 16. Effectiveness of Design and Engineering for Start-ups and Shut-downs



Less than *Very Effective* 86% *51 responses, 0% missing*

Figure 17. Effectiveness of Managing the Change of Systems for Start-ups and Shut-downs



Less than *Very Effective* 81% *49 responses, 4% missing*

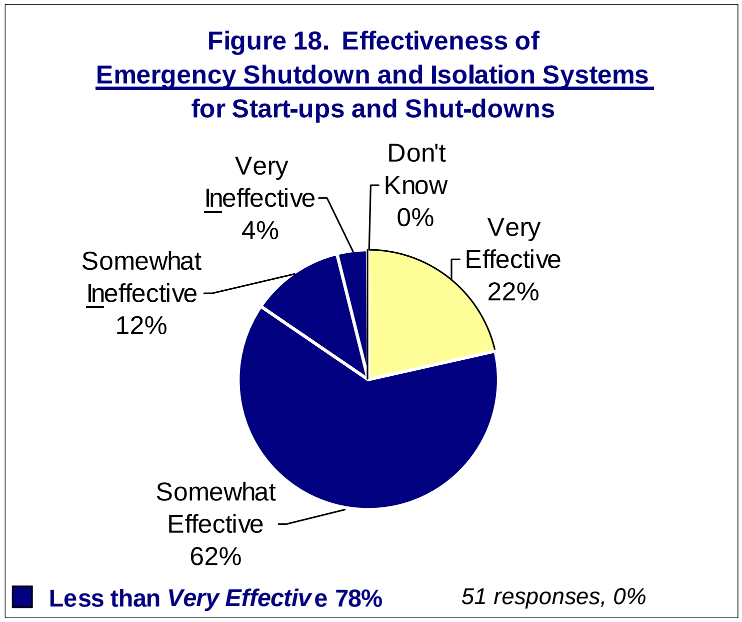


Figure 18. Effectiveness of
Emergency Shutdown and Isolation Systems
for Start-ups and Shut-downs
Very Ineffective 4%
Don't Know 0%
Very Effective 22%
Somewhat Ineffective 12%
Somewhat Effective 62%
Less than Very Effective 78%
51 responses, 0%

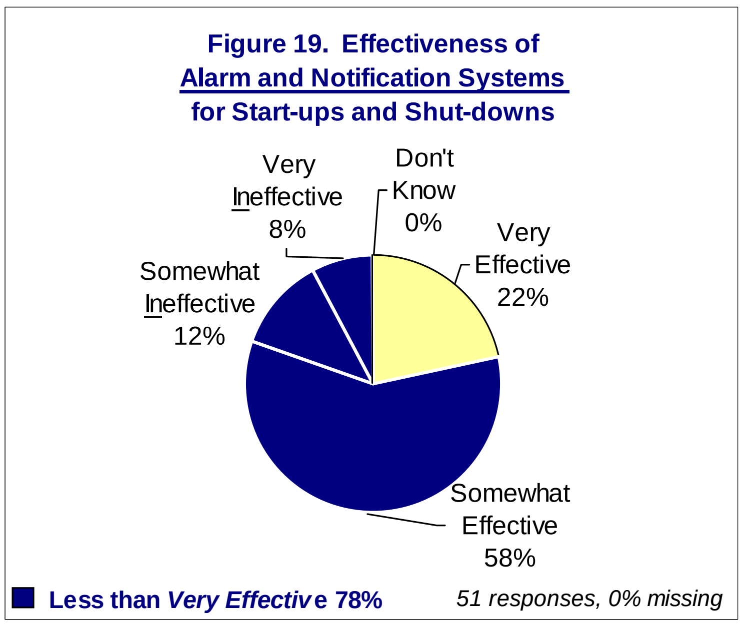
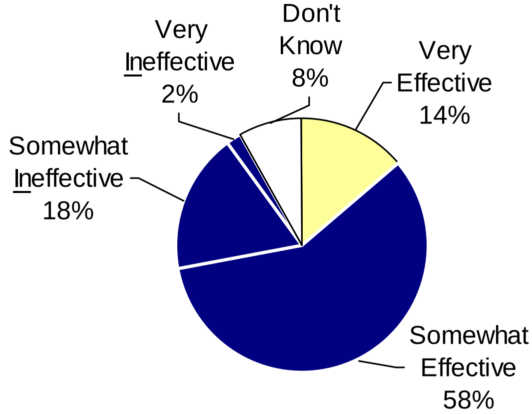


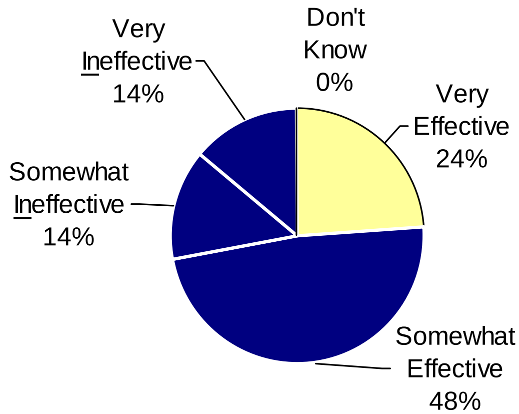
Figure 19. Effectiveness of
Alarm and Notification Systems
for Start-ups and Shut-downs
Very Ineffective 8%
Don't Know 0%
Very Effective 22%
Somewhat Ineffective 12%
Somewhat Effective 58%
Less than Very Effective 78%
51 responses, 0% missing

Figure 20. Effectiveness of Process Hazard Analyses (PHAs) for Start-ups and Shut-downs



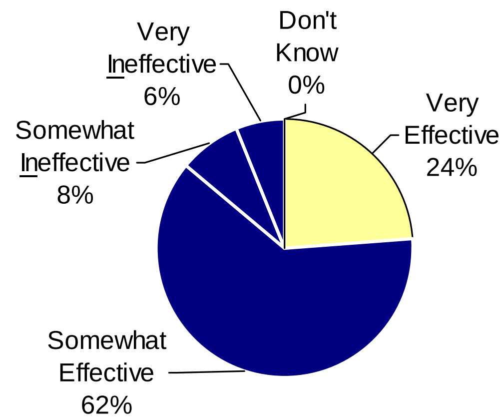
Less than *Very Effective* 78% *51 responses, 0% missing*

Figure 21. Effectiveness of Communication Systems within the Plant for Start-ups and Shut-downs



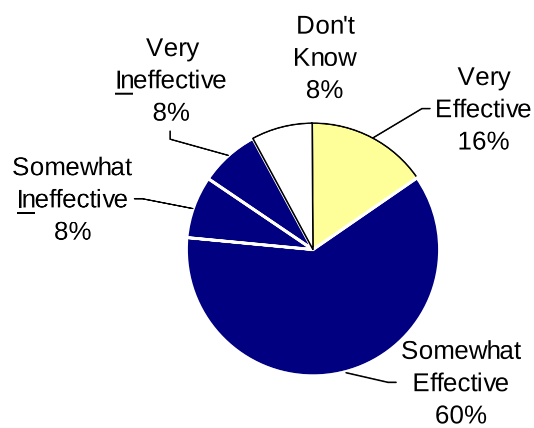
Less than *Very Effective* 76% *50 reaponses, 2% missing*

Figure 22. Effectiveness of Monitoring, and Measurement Systems for Start-ups and Shut-downs



Less than *Very Effective* 76% *49 responses, 4% missing*

Figure 23. Effectiveness of Systems for Containing Hazardous Materials for Start-ups and Shut-downs

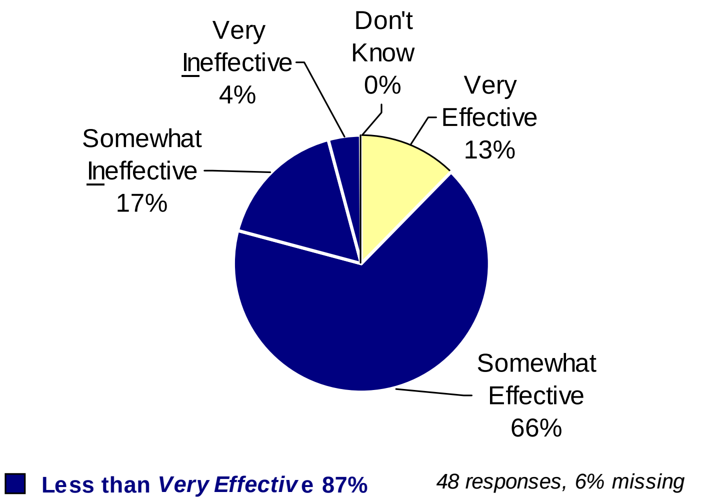


Less than *Very Effective* 76% *51 responses, 0%*

Overall Management of Process Safety Systems

In addition to asking respondents about specific process safety systems for start-ups and shutdowns, the survey asked respondents to rate the overall management of process safety systems at the refinery. Thirteen percent rated it is as *very effective*. Nearly 9 of 10 (87%) rated the overall management of process safety systems at their refineries as <u>less than</u> *very effective.* (See Figure 24.)

Figure 24. Overall Effectiveness of Management of Process Safety Systems



48 responses, 6% missing

Study Limitations

The findings of this study may be limited because many of the study's findings provide respondent perceptions rather than independent assessments (e.g., regarding effectiveness, preparedness, confidence in systems, or employer actions). Further, findings from this study cannot be generalized beyond those sites that participated in the study.

While these findings cannot be taken to represent conditions at refineries that are not included in this study, it may be appropriate to consider that refineries with union representation have greater organizational mechanisms and resources, such as joint-labor management health and safety committees, full and part-time local union health and safety representatives and international union health and safety staffs and programs, with which to positively affect process safety. Accordingly, the findings from this study may be able to be considered "best case" findings.

Discussion and Conclusions

Highly Hazardous Conditions Similar to Those Found at BP Texas City Are Pervasive in US Refineries

Ninety percent of the 51 refineries reported the presence of at least one of these three *highly hazardous conditions* (43% reported three *highly hazardous conditions,* 35% reported two conditions, and 12% reported one condition). Two-thirds or more of the respondents reported the presence of each of these three *highly hazardous conditions* in the last three years (78% placed trailers or other unprotected buildings in hazardous areas, 70% had non-essential personnel present in vulnerable areas during start-ups and shut-downs, and 66% had atmospheric vents on process units).

There Remains an Alarming Potential for Future Disasters

The findings indicate that the U.S. refinery industry remains plagued by the threat of refinery catastrophes like the fires and explosions that engulfed workers at BP's Texas City refinery—catastrophes that are preventable. Moreover, 61% of respondents from these sites reported at least one incident or near miss involving at least one of the targeted four *highly hazardous conditions* in the past three years. Of these incidents 10% - involved all four *highly hazardous conditions* (10% involved three conditions, 14% involved two conditions, and 27% involved one condition).

Industry Response Since Texas City Has Been Anemic

Stark and hard lessons from the myriad of refinery incidents and near misses prior to BP Texas City have been explicitly outlined but have largely been ignored. Following each catastrophe, refinery workers, their union, and occupational health professionals hoped and expected that there would be a flurry of activity to improve process safety in areas that prompted the disaster. However, even the most recent disaster in Texas City, the worst since passage of the OSHA Act and the Process Safety Management Standard, reportedly yielded either widespread inaction or insufficient action — each of which threatens more catastrophes.

The survey findings highlight that following the Texas City disaster a substantial majority of refineries with one or more of the four *highly hazardous conditions* either took *no action* or took actions judged less than *very effective*. Consistent with this inaction, a sizeable number of sites that had these *highly hazardous conditions* reported an absence of training regarding the prevention of catastrophic events. In addition, a majority of these same sites reported a need for such training. Indicating a lack of local union involvement, a substantial minority of responding sites stated they did not know if the company had provided training on these conditions.

In spite of these findings, there was a glimmer of hope among the widespread reports of faulty systems, insufficient action, and an industry penchant for risk taking. There is evidence from this study that refineries with identified problems can take very effective action on critical health and safety issues, although to date most have not. These positive reports, though limited, provide the beginnings of benchmarks for the rest of the industry.

The Letter and the Spirit of OSHA's Process Safety Standard Remain Unfulfilled

The study findings demonstrate that for the refining industry, the letter and spirit of OSHA's Process Safety Management of Highly Hazardous Chemicals standard remain unfulfilled. The heightened risks present during refinery process start-ups and shutdowns demand that these systems be highly reliable and at peak effectiveness. Pre-start-up safety reviews are an essential tool for identifying and correcting an array of potentially disastrous refinery conditions and are included in the Process Safety Management standard.

The prevalence of the four *highly hazardous conditions* and related incidents and near misses during the process start-ups and shutdowns, as reported by respondents, indicates that at many sites these reviews lack the robustness intended in the Process Safety standard. A solid majority of respondents individually rated each of 16 process safety systems used during start-ups and shutdowns as <u>less than</u> *very effective.* More than three-quarters of respondents rated 10 of the 16 systems as <u>less than</u> *very effective.* And further, 87% rated the overall management of process safety systems at their sites as <u>less than</u> *very effective*.

With very infrequent OSHA inspections,[43] the refining industry has been left largely to voluntary self-regulation, thus undermining a necessary driving force for highly effective process safety systems. The absence of OSHA enforcement has facilitated management decisions that undermine the health and safety of workers, communities and the environment. Decisions made by oil companies, based in part on inadequate trade association guidelines,[44, 45] have led to the widespread presence of the *highly hazardous* conditions targeted in this study.

Inadequate Staffing and Poor Work Organization Increase the Risk of Catastrophic Accidents

Virtually every safety system examined in this study is highly dependent on the presence of highly qualified employees in sufficient numbers to handle normal, abnormal, and emergency situations. This is not the picture painted by this study's findings. Almost nine out of ten respondents rated work organization and staffing as <u>less</u>

than very effective. These findings are consistent with problems of staffing, work organization and hours of work reported by the CSB[1] and the BP U.S. Refineries Independent Safety Review Panel[6] regarding the 2005 BP Texas City disaster.

Contractors and those who work for them are a very substantial part of the workforce at most every refinery. The 15 workers who died in the BP Texas City disaster were all contract workers. Although these 15 were not engaged in activities that contributed to the BP incident, lessons from previous disasters have shown that contractors need to play important roles in prevention. In this study, the preparedness of contractors to contribute to incident prevention received the poorest ratings of any item in the survey.

Refineries are Not Sufficiently Prepared for Emergencies

Taken together, the hazards and risks outlined in the history of refinery disasters along with respondents' reports in this study amplify to extraordinary proportions the need for very effective emergency preparedness and response. However, it appears that the refining industry is under prepared for these emergencies. While 30% of respondents rated their sites as *very prepared,* some of the highest ratings in this entire study, the remaining 70% reported that their refineries were less than *very prepared.*

Emergency response training and frequent drills are critical to having a workforce prepared to respond to a hazardous materials incident. While nearly all of the study respondents reported training at their sites in the previous 12 months for emergency response or hazmat teams or fire brigades, only 77% of sites reported emergency response training for the general plant population in the past year. Thus, the data show that workers at approximately one in four refineries labor in highly volatile situations without up-to-date training. Further, only one-quarter of respondents reported being *very confident* that the workforce at their site had received the training it needed to respond safely to a serious hazardous materials incident or emergency.

Proactive OSHA Regulation and Enforcement Are Essential: In sharp contrast to other high hazard industries such as aerospace, aviation, and nuclear power which are specifically required to perform to very high standards, government regulators have not yet demanded that the refining industry invest the necessary resources to be fully protected and secured. For example, policymakers and the public would find it unacceptable if there were widespread reports from airline pilots or mechanics that take-offs and landings were occurring with less than fully effective critical safety systems. However, this study's findings suggest such "take-offs" and "landings" occur regularly at refineries, thereby threatening the lives of hundreds or thousands of workers, nearby community members and the environment. Given that petroleum refineries are a vital part of the nation's energy infrastructure, prompt government intervention including strengthened OSHA standards and rigorous enforcement must be put in place.

In particular, OSHA should update and strengthen its 1992 standard on "Process Safety Management of Highly Hazardous Chemicals" (29 CFR 1910.119). For example, facilities should be required to report to OSHA when their use of highly hazardous chemicals in large quantities meets the standards' provisions for coverage. The standard currently covers flammable, explosive and toxic chemicals, but not chemicals that can undergo a catastrophic runaway reaction. The CSB has recommended that OSHA correct this deficiency, but the Agency has taken no action. The rulemaking should also consider incorporating the process safety metrics and the safe siting guidelines currently under development. The Agency could also write many of the urgent and critical actions listed in the next section into regulatory language.

Changes in other regulations would also be useful. In particular, all facilities that employ outside contractors should be required to keep a log of injuries and illnesses for all workers on the site. It was absurd that BP was not required to report any of the workers killed in its Texas City disaster on its log of occupational injuries and illnesses. This was the case because BP did not directly employ any of those killed—they were contractor employees.

Of course, OSHA standards are useless without strong enforcement. At the time of the BP disaster, OSHA had few inspectors trained to enforce its Process Safety Standard. The Agency has begun to train additional inspectors, but more could and needs to be done. Even with the additional inspectors, OSHA must commit to using the standard vigorously. Too often, OSHA measures its productivity by comparing the number of inspections and citations with the inspection time needed to generate them. However, process safety inspections are complicated and time consuming. As such, they do not fit well into this naïve measure of productivity. OSHA needs to ensure that it gives such inspections the time, resources and high priority they deserve.

The Oil Industry Should Promptly Address Critical Deficiencies in Process Safety Management

Process changes, replacement of antiquated equipment, preventative maintenance, adequate staffing, and other measures required for high reliability and excellence in process safety all require financial investment. Oil refiners, like BP, are reporting enormous, record breaking profits. Yet in the face of increased earnings, the

Chemical Safety Review Board recently reported that cost-cutting played a major role in undermining process safety in Texas City.[1] Too often, the vast wealth of the refinery industry has remained sequestered from the responsibility to prevent future horrors like that which took place March 23, 2005.

The study findings document that critical process safety deficiencies are endemic within the industry. Preliminary studies about the March 23, 2005 BP Texas City disaster indicate that an extraordinary number of the industry-wide deficiencies found in this study mirror those found at BP.

In order to prevent similar incidents in the future and to provide refinery workers, emergency responders, and surrounding communities with their rightful protection from harm, the USW asserts that the following actions are necessary.

Essential Actions

The USW calls on the refining industry to initiate action immediately on the ten measures listed below. These critical improvements will advance the pursuit of excellence in process safety management and protection of the nation's workers, infrastructure and security. To be fully effective, it is necessary for refineries to work with workers and their local and international union representatives to develop and implement these improvements.

Urgent and Critical Actions

1. **Establish a Process Safety Team as part of the Health and Safety Committee at each refinery**, including representatives selected by the local union, to plan, review, monitor, and audit all process safety activities including the following additional nine essential actions.

   At a minimum, the Process Safety Team must include union-appointed members including, but not limited to: a) Lead Operators, b) one or more maintenance workers, and c) local union health and safety leaders (for example, Process Safety Representatives, Health and Safety Representatives, or Health and Safety Committee members). Process Safety Representatives are envisioned as additional local union health and safety representatives with specific duties related solely to process safety.

   To be effective, management must provide all Process Safety Team members, including union-selected representatives, with training in topics related to process safety management. This training must be sufficient to provide team members with a working knowledge of process safety management concepts, issues, regulations, and standards sufficient for them to carry out their responsibilities on the team. This training should include, but not be limited to, all elements of OSHA's Process Safety Management Standard (1910.119) including pre-start-up (and shutdown) safety review, OSHA's Hazardous Waste Operations and Emergency Response Standard (1910.120), essential actions covered in this section, and other specific topics as needed, such as, how to read piping and instrument diagrams (P&IDs). At a minimum, there must be 160 hours of initial training and 80 hours of advanced and/or refresher training annually. The union shall have the right to select the training for its members on the team.

2. **Ensure that process hazard analyses (PHAs) exist for all potentially hazardous operations and that PHAs are reviewed and revalidated at least every three years.** In addi

tion to engaging the Process Safety Team in this work, working PHA teams must include workers with both experience-based process expertise and knowledge in the specific process hazard analysis methodologies used in the PHA. The teams must also have information and the authority to ensure that all recommendations arising from a PHA are prioritized and receive timely action.

At a minimum, the PHA revalidation process must include: a) a critical review of all underlying assumptions, b) review of all changes since the previous analysis, c) review of relevant incident and near miss histories, d) application of relevant lessons learned, and e) a review of all managed changes (MOCs). Every incident must initiate a review of an existing PHA to determine if there were inadequacies or there are needed improvements. The Process Safety Team or its designees must be involved in all PHA development and revalidation. All action items must be followed to completion in a specified time frame.

3. **Address the four *highly hazardous conditions* associated with the March 23, 2005 BP Texas City disaster:**

   a. **Eliminate all atmospheric vents on process units** that could release untreated explosive, flammable, or toxic materials to the atmosphere. This must include all “blow-down” systems that could release overflows directly to the atmosphere (see CSB recommendaitons[1]).

      As soon as is possible, management must assess all vents for their potential to release directly to the atmosphere and connect all atmospheric vents to systems that treat or control the hazards (such as scrubbers or flares) in order that the vents no longer pose a threat of releasing untreated explosives, flammables, or toxic chemicals directly to the atmosphere.

   b. **Manage instrumentation and alarms** in a manner that ensures that they are sufficient and functional for all anticipated potential conditions and that there are no start-ups without tested and documented functioning of all process instrumentation and alarms (including calibrations and checks of interlocks). The Process Safety Team must oversee this testing and documentation. To this end, it is necessary that the Process Safety Team review all relevant process hazard analyses (PHAs) prior to any planned start-up or shutdown to ensure that instrumentation and alarms are sufficient and functional for all anticipated potential conditions including emergencies.

      There must be redundancy in safety-critical instrumentation.

c. **Create a definition of "safe siting"** that when followed will ensure that refiners locate all trailers or other unprotected buildings in areas that could not expose occupants to harm from explosions, fires, or toxic exposures.[46] Work in creating this definition is currently under way through the American Petroleum Institute.

This recommendation is consistent with that made by the CSB in October 2005[47] In addition to the relocation of trailers and other unprotected buildings, refiners should:

- Immediately cease reliance on American Petroleum Institute's (API) Recommended Practice (RP) 752, Management of Hazards Associated with Location of Process Plant Buildings.[48] As demonstrated by the BP Texas City disaster, this Recommended Practice is inadequate for the establishment of minimum safe distances for trailers or other unprotected buildings. The guidelines to replace this document must be acceptable to all stakeholders including workers and their unions.
- Blast Resistant Modules (BRMs) are not to be used in lieu of trailers such that they would put occupants at risk for injuries or adverse health effects from: a) explosions (possibly resulting in impacts or rollovers), b) fires, or c) exposures to toxic chemicals. For operations personnel, BRMs shall be located only in areas where they will provide protections equal to or greater than those provided by properly designed and situated stationary control rooms.

d. **Ensure that all non-essential personnel are outside of hazardous areas** (vulnerability zones), especially during start-ups, shutdowns, or other unstable operating conditions.

All refineries need to immediately review current policies and implement changes as necessary to ensure that non-essential personnel are outside of hazardous areas where there is any possibility that process malfunctions could expose them to explosions, fires, or toxic exposures. This must include those exposures that could be associated with start-ups, shutdowns, or other unstable process operating conditions. More specifically, all non-essential workers, including maintenance and contract workers, should be documented to be out of hazardous areas prior to start-up.

4. **Develop and implement policies requiring full safety reviews prior to all process start-ups and scheduled shutdowns.** The preexisting OSHA requirement for process safety reviews for start-ups must be expanded to cover shutdowns. In addition, the requirement for such reviews must not be limited to

new or modified processes, that is, reviews must occur for every start-up or scheduled shutdown. (See endnote for items to be included in reviews) [49] All reviews must include the Process Safety Team.

5. **Provide adequate staffing** to ensure safe operation in all potential operating circumstances including day-to-day operations, start-ups, shutdowns, abnormal conditions and upsets, and emergencies. Staffing must ensure that all members of the workforce are able to carry out their work alertly and without adverse health effects. A primary method for achieving adequate staffing must be the filling of all open positions on shift-team rosters. This must include staffing sufficient to prevent position vacancies due to staff reassignments to special projects or to off-unit positions such as unit trainers as well as vacations and anticipated levels for temporary absences due to illness and family emergencies. Safe staffing must include limits on the number of consecutive work days and hours, as agreed upon through negotiations with the union. The USW supports the recommendations of the BP U.S. Refineries Independent Safety Review Panel[6] and the U.S. Chemical Safety Board in relation to staffing and fatigue prevention.[1] Adequate staffing must include each of the following:

    - There must be sufficient staffing, including personnel having special skills and qualifications, to handle process systems in both normal and abnormal circumstances including emergencies. This is especially so for the greater risks involved in start-ups and shut-downs. At a minimum, there should be double staffing for all start-ups and shutdowns. Critical maintenance personnel must be on standby and fire and rescue teams must be alerted for all start-ups and shutdowns.

    - There should be duty limits negotiated with the union that are informed by current research, guidelines and regulations in other industries (for example, aviation, trucking, or railway) related to safety and health, hours of work, and shifts and limits.

    - Contract workers must be strictly limited to those who have demonstrated sufficient knowledge, experience, technical and communication skills, and training to ensure they can effectively contribute to refinery accident prevention. Prior to the hiring of contractors, management must have evidence that such competence exists. Management must only engage full-time employees (rather than contractors) in safety-critical process operations.

- The Process Safety Team must have a say concerning work organization and staffing as they affect process safety. The team must also have a role in monitoring the safety performance of all contract personnel as it pertains to process safety.

Necessary Supporting Actions

6. **Provide effective, participatory worker training and drills** in the areas of: a) process safety management, b) emergency preparedness and response, and c) pre-start-up and shutdown safety reviews. Training must be tailored to meet the needs of both the general plant population and those in specialized process safety roles. Selection and presentation of training must be carried out in conjunction with the union using its nationally recognized model programs. The recommendation is consistent with the BP U.S. Refineries Independent Safety Review Panel's call for the development of process safety knowledge and expertise.[6]

   Participatory process safety-related training and drills for both the general plant population and those in specialized process safety-related roles must include:

   - **Process safety management training and drills** must be sufficient for workers to gain knowledge and skills necessary for them to safely carry out their responsibilities related to process safety. This training must include, but not be limited to, the elements of OSHA's Process Safety Management Standard (1910.119) and other process safety-related subjects covered in this report. At a minimum, there must be 40 hours of initial training and 16 hours of refresher training annually for the general plant population. For Health and Safety Committee members, union officers, and stewards, there should be 80 hours of initial training and 16 hours of refresher training annually. There must be pre-start-up (and shutdown) safety review training and drills for all those who will have roles in these activities or have the potential to affect, or be affected by, these activities.
   - **Emergency preparedness and response training and drills**. At a minimum, there must be 80 hours of initial and 40 hours of annual advanced and/or refresher training for all fire brigade, hazmat team, or other workers with emergency response duties above the OSHA 1910.120 Awareness Level. There must be at least 24 hours of initial training and eight hours of refresher training annually for the general plant population.

Training listed above for Process Safety Team members may be used to satisfy these training requirements.

7. **Ensure that all operating manuals and procedures are in optimum working order**, that is, in writing, up-to-date, understandable, functional, available and properly used for the safe operation of all processes. The manuals and procedures must cover normal, abnormal, upset, and emergency operating conditions, shut-downs and start-ups.[50]

   Management must ensure that written operating procedures for the safe operation of all processes are available and followed. This must be so in regard to both normal and abnormal operating conditions as well as emergencies. The operating procedures must be understandable and functional and must include limits for process variables and abnormal situation management (ASM) (e.g., actions required when there are instrumentation failures, abnormal readings, or other unforeseen circumstances, including emergency shutdowns). Operating procedures must include variance protocols and procedures for any deviations, including management of change procedures as well as when to request an updated hazard analysis.[24]

   - A team of operators, maintenance staff, and others with roles in the process must be involved in the periodic review and modification of all procedures. Procedures must be kept up-to-date and take into account any significant changes in plant design, operation, near misses or incidents experienced in the process in question, or lessons learned from similar operations.

   - All those involved in the oversight or execution of the procedures must receive initial and periodic training, including simulations, sufficient to ensure that they can play required roles in the procedures. This is consistent with the CSB recommendation on training.[1] The training and simulations must emphasize safety critical factors, especially as they relate to prevention of releases of hazardous chemicals, fires, and explosions. Training must also include operations during abnormal conditions, emergency operations, protection of personnel, and any modifications to the process or procedures. Those trained must also have a role in identifying and addressing weaknesses in procedures and in establishing their practicality.

8. **Review and update management of change (MOC) procedures** (including organizational, personnel, and process changes) to ensure that these procedures meet the requirements of OSHA 1910.119 and recommendations of the U.S.

9. Chemical Safety Board[1, 24] including that the Center for Chemical Process Safety issue new MOC guidelines. The Process Safety Team or its designees must be involved in all MOCs.

10. **Implement an effective incident and near miss investigation program at each site** that involves workers and their unions in all phases of investigation and recommendations for improvement. The USW's Triangle of Prevention (TOP) Program is a model in operation at 15 U.S. refineries and nine other petrochemical facilities. (See Appendix A, Description of the USW Triangle of Prevention (TOP) Initiative)

    The Process Safety Team must be involved in investigating all incidents and near- misses including identified process safety hazards. The investigation program needs to include root cause analysis, recommendations for correcting identified causes using a hierarchical safety systems approach, tracking of corrections to completion, and dissemination of findings including all lessons learned. The metrics driving this program must be actual improvements made and hazards eliminated or diminished rather than recommendations or activities.

11. **Develop and implement a national set of standardized process safety metrics and benchmarks** to assess leading and lagging indicators of process safety that can help ensure that sites are able to identify and correct deficiencies and improve programs, thereby preventing process safety incidents. Workers and their unions should play a major role in both development and implementation of these metrics.

    Metrics systems to assess leading and lagging indicators of process safety should be consistent with initiatives by the United Kingdom's Health and Safety Executive[51] and the Center for Chemical Process Safety (CCPS)[52] as well as the recommendations of the BP U.S. Refineries Independent Safety Review Panel[6] and the U.S. Chemical Safety Board.[1] The systems of metrics and benchmarks must emphasize process safety performance indicators rather than those focused on personal injuries, and leading indicators of process safety performance above lagging ones. The process safety metrics must be used as tools to drive performance. The CSB has requested that the National Academy of Sciences convene a panel to consider such metrics. Preliminary work is also being done under the auspices of the Center for Chemical Process Safety.

The USW also supports recommendations made by the U.S. Chemical Safety and Hazards Investigation Board (CSB) for BP in its March 2007 report.[1] These recommendations must be reviewed and adopted as needed by every North American refinery.

The potential for management to join labor in identifying and acting to solve process safety problems is evidenced by a 2007 joint initiative between the United Steelworkers and BP.[53] This initiative, consistent with CSB recommendations, expresses a commitment "to ensure the safest possible conditions for BP employees and neighbors of BP facilities" and is "based in part on the findings and recommendations of the BP US Refineries Independent Safety Review Panel, the preliminary reports of the U.S. Chemical Safety and Hazard Investigation Board, BP's own investigations, and the experience of the USW." The initiative addresses the immediate causes of the Texas City tragedy, the formation of process safety teams, accident and near-miss investigation, review of safe operating procedures, health and safety education, staffing and reasonable work hours, operator leadership, maintenance, teamwork, environmental protection for corporate neighbors and additional measures as identified. The USW asserts that these essential actions build on existing reports and will strengthen their recommendations. (See a copy of the United Steelworkers and BP agreement in Appendix B) This agreement is also consistent with the recommendations of the BP U.S. Refineries Independent Safety Review Panel[6] (Baker Panel) calling for process safety leadership.

Further, the USW concurs with the Baker Panel regarding the need for leadership in process safety, an integrated and comprehensive process safety management system, process safety audit systems, and process safety culture.[6] It must be noted that the union, by necessity of its nature and mission, will have unique aspects to its perspective on these issues.

Appendix A.
Description of the USW Triangle of Prevention (TOP) Initiative

USW Triangle of Prevention Initiative—TOP

The United Steel Workers, through the USW Triangle of Prevention (TOP) Initiative, has proven that workers and their unions are critical partners in identifying and controlling workplace hazards. They do this as full participants in designing, developing, evaluating and maintaining TOP as a vital component of plant health, safety and environment.

The TOP Initiative seeks to identify and dismantle barriers to identifying and controlling workplace hazards. It does this by directly confronting two of the most serious obstacles: first, the blame culture that surrounds accident and near-miss reporting; and second, the lack of worker-friendly methodologies (tools) and training for uncovering and reporting workplace hazards.

TOP's approach incorporates a hierarchy of "systems of safety" for prevention. The Initiative uses the systems of safety hierarchy for identifying both failures and solutions affecting workplace health, safety and environment issues. The hierarchy begins at the highest level with 1) design and engineering, followed in descending order by, 2) maintenance and inspection, 3) mitigation, 4) warnings, 5) training and procedures, and 6) personal protective factors. Identifying and correcting hazards before accidents occur is the key to any health and safety program. The systems of safety approach accomplishes this by incorporating fundamental concepts and applying them to the practical, everyday operations in the workplace.

Within TOP, labor and management jointly use a rule-based investigation methodology based on logic tree diagramming to find root causes and systems failures. Investigation teams use this methodology to investigate all incidents and near misses at the worksite. After determining the root causes, the team develops recommendations for corrective actions using the hierarchical systems approach and tracks them to completion.

Every investigation provides the opportunity to learn. By applying solutions not only to the hazards investigated, but also to all similar conditions in the facility. TOP promotes continuous learning and improvement. The Initiative is designed so that every investigation has the potential to leverage improvements in other areas of the facility. Further, through its lessons learned component, TOP transmits these lessons to health and safety committees both within and across plants. Accordingly, employees at other sites and the USW International Union Health, Safety and Environment Department often learn from the information. TOP uses mini-training sessions, bulletin boards, tool-box safety meetings, personal testimony and more to transmit the lessons to everyone in a plant. Lessons learned may be shared with concerned parties outside the corporation, by mutual consent of the union and employer.

For too long the only metrics used to assess safety in the refining industry have been those related to "Personal Safety," e.g., the OSHA 300 Log. The refining industry has not developed or used effective metrics for "Process Safety." To solve this problem, the USW developed as part of TOP a broader index that measures injuries to people, harm to the environment and damage to equipment. The index also includes the ratio of completed versus uncompleted action items to indicate the efficiency of their implementation. The combination of these measurements yields a more accurate indication of the "health" of each site's health, safety, and environmental programs.

Appendix B.
USW BP Joint Initiative on Health and Safety

USW BP Joint Initiative on Health and Safety

BP and the United Steelworkers are determined to ensure the safest possible conditions for BP employees and neighbors of BP Refineries. To that end, BP will work with USW on a joint safety initiative, based in part on the findings and recommendations of the BP US Refineries Independent Safety Review Panel, the preliminary reports of the U.S. Chemical Safety and Hazard Investigation Board, BP's own investigations, and the experience of the USW.

1. BP will promptly address the immediate causes of the Texas City tragedy, throughout the corporation.
2. BP and the USW will establish joint process safety teams.
3. BP and the USW will establish a joint program for accident and near-miss investigations, and for reviewing safe operating procedures.
4. BP and the USW will work together to upgrade safety education programs.
5. BP will ensure that its facilities are adequately staffed and that employees have reasonable hours of work.
6. The Chief Operator position will be reestablished where it does not now exist, so long as it enhances safety in the refineries.
7. BP will ensure adequate internal maintenance forces.
8. BP will work with the USW and appropriate community officials and organizations to ensure that the corporation is a good environmental neighbor.
9. BP and the USW will define and ensure we have effective teamwork in the refineries.
10. BP and the USW will establish a structure for implementing and overseeing this initiative.

This is an agreement in principle; many details remain to be determined, and additional measures may be added later.

Appendix C.
USW Refinery Survey Questionnaire

USW Survey on Refinery Accident Prevention

Based on the Catastrophe at BP's Texas City Refinery March 23, 2005

Table of Contents

Preliminary Findings from the BP Texas City Disaster

On March 23, 2005 fires and explosions at BP's Texas City refinery killed 15 workers and injured over 170 others. Preliminary findings from the investigation of the disaster suggest that four factors played a major role in the isomerization unit explosions.

1. **A vent stack on a blow-down system.** The company used a vent stack on a blow-down system to relieve a build-up of pressure on a process unit. This vent system released flammable and explosive liquids and vapors directly to the atmosphere. This type of vent system is out-of-date and not as safe as systems that send materials to flares or other systems that contain and neutralize hazards.

2. **Management of instrumentation and alarm systems.** Key management systems were not working effectively. This allowed system indicators and alarms to malfunction and provide operators with faulty information.

3. **The safe siting of trailers.** The company sited trailers near a processing unit where workers were exposed to the release of hazardous materials, fires and explosions.

4. **Non-essential personnel.** The company started-up a processing unit containing flammable and explosive materials while non-essential personnel were in the area.

About This Survey

The questions in this survey focus on these and other safety and health systems at your worksite. We are sending this survey to all USW refinery locals. USW will use this information to:

a) assess the health and safety needs of refineries,

b) develop health and safety programs to meet those needs, and

c) provide information to organizations that may be able to affect refinery health and safety such as the U.S. Chemical Safety Board (CSB).

USW will group data from all sites together before it presents them in reports. While the Health and Safety Department may review and use data from individual sites, we will not identify any individual site data in the study reports we write.

If your local represents workers at more than one refinery, we need your local to **complete a separate questionnaire for each refinery**.

When answering the questions please make your marks dark and clear when selecting your choice. See the following example:

Yes	No
●	O

Section 1: Atmospheric Venting of Toxic or Hazardous Materials on Process Units

In this survey, when we say, "atmospheric vents,'' we mean:

- only vents on process units (not those on tank farm vessels)
- atmospheric vent stacks on blow-down systems, or
- other vent systems that could release untreated flammable, explosive, reactive, toxic or otherwise hazardous materials directly to the atmosphere.

1. Does your facility **use these types of atmospheric vents** (see note above)? Please mark one.

Yes	**No**	**Don't Know**
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 2** on page 4.

If you answered, **"Yes,"** please **continue with question 2** below.

2. **a.** How many of these types of atmospheric vents are there at your worksite? Please mark one.

1 to 10	**11 to 20**	**21 to 30**	**31 or more**
O	O	O	O

b. In the box below, please **list the types of process units** at your worksite **that have these types of atmospheric vents**. If you need more space, use the back of this page and write "2. b." next to your response.

3. a. Since March 23, 2005 when the BP Texas City refinery exploded, **has the company at your site taken action** to replace atmospheric vents with safer venting systems? Please mark one.

Yes	**No**	**Don't Know**
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 2** on page 4.

If you answered, **"Yes,"** please **continue with part b** of this question below**.**

b. In the box below, please **describe the company's actions** to replace atmospheric vents with safer venting systems. If you need more space, use the back of this page and write "3. b." next to your response.

c. Please think about the actions your company has taken at your worksite since the March 23, 2005 explosion at the BP Texas City refinery. **Overall, how effective have the company's actions been** in preventing a catastrophic event involving atmospheric vents?

Very effective	**Somewhat effective**	**Somewhat ineffective**	**Very ineffective**	**Don't know**
O	O	O	O	O

Section 2: Management of Instrumentation and Alarm Systems

4. **a.** Again, we are asking about company actions since the March 23, 2005 catastrophe at the BP Texas City refinery. In this question, we want to know about all instrumentation, including level indicators and alarms that would signal any abnormal or emergency conditions during process start-ups or shut-downs. **Has the company acted** to ensure that all instrumentation will function properly (that is, it has been inspected, maintained and tested)? Please mark one.

Yes	No	Don't Know
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 3** on the next page.

If you answered, **"Yes,"** please **continue with part b** on this page.

b. Using the box below, please **describe the company's actions** since March 23, 2005 to improve the management of all instrumentation for start-ups and shut-downs, including level indicators and alarms. If you need more space, use the back of this page and write "4. b." next to your response.

c. Think about the actions your company has taken at your worksite since the March 23, 2005 explosion at the BP Texas City refinery. **Overall, how effective have the company's actions been** in ensuring that instrumentation will provide for safe start-ups and shut-downs? Please mark one.

Very effective	Somewhat effective	Somewhat <u>in</u>-effective	Very <u>in</u>effective	Don't know
O	O	O	O	O

Section 3: Improper Siting of Trailers or Other Unprotected Buildings

In this survey, when we say, "trailers or other unprotected buildings inside potentially hazardous areas,'' we mean:

- those buildings where people work, meet or congregate, and
- siting of buildings in high hazard or vulnerability zones where occupants could be exposed to fires, explosions or releases of toxic or hazardous materials.

5. Does the company have **formal written policies** prohibiting the siting of trailers or other unprotected buildings inside potentially hazardous areas**?**

Yes	**No**	**Don't Know**
O	O	O

6. In the past three years, has the company **placed trailers or other unprotected buildings inside potentially hazardous areas**?

Yes	**No**	**Don't Know**
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 4** on page 8.

If you answered, **"Yes,"** please **continue with question 7** on the next page.

7. For this question, again think about the past three years. Please use the lines below to **describe the following:**

- approximate number of trailers or other unprotected buildings the company placed inside potentially hazardous areas
- locations where the company placed these trailers or other unprotected buildings, and
- potential hazards and processes involved.

If you need more space, use the lower part of this page.

Trailers or Other Unprotected Buildings

Approximate Number	Locations on Plant Site	Processes and Potential Hazards
________	____________________	________________________________
________	____________________	________________________________
________	____________________	________________________________
________	____________________	________________________________
________	____________________	________________________________
________	____________________	________________________________
________	____________________	________________________________

8. **a.** Since the March 23, 2005 when the BP Texas City refinery exploded, **has the company taken action** to prevent a similar catastrophe by moving trailers or other unprotected buildings outside of potentially hazardous areas? Please mark one.

Yes	No	Don't Know
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 4** on the next page.

If you answered, **"Yes,"** please **continue with part b** of this question below.

b. Using the box below, please **describe the company's actions** since March 23, 2005 to move trailers or other unprotected buildings outside potentially hazardous areas. If you need more space, use the back of this page and write "8. b." next to your response.

c. Think about the actions your company has taken at your worksite since the March 23, 2005 explosion at the BP Texas City refinery. **Overall, how effective have the company's actions been** in protecting workers in trailers or other unprotected buildings? Please mark one.

Very effective	Somewhat effective	Somewhat ineffective	Very ineffective	Don't know
O	O	O	O	O

Section 4: Non-Essential Personnel in Potentially Hazardous Areas During Process Start-Up or Shutdown

9. Does the company have **formal written policies regarding the presence of non-essential personnel** in areas where they could be vulnerable to a toxic or hazardous materials release, fire or explosion during a process start-up or shutdown?

Yes	No	Don't Know
O	O	O

10. In the past three years, has your site **engaged in process start-ups or shutdowns where non-essential personnel were in areas vulnerable** to a toxic or hazardous materials release, fire or explosion?

Yes	No	Don't Know
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 5** on page 10.

If you answered, **"Yes,"** please **continue with the next question** below.

11. a. Since the March 23, 2005 BP Texas City refinery explosion, **has the company taken action** to ensure that all non-essential personnel are at a safe distance during a process start-up or shutdown of hazardous operating units? Please mark one.

Yes	**No**	**Don't Know**
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to Section 5** on page 10.

If you answered, **"Yes,"** please **continue by answering part b** of this question below.

b. Using the box below, please **describe the actions the company has taken** since March 23, 2005 BP explosion to ensure that all non-essential personnel are at a safe distance during a start-up or shutdown of hazardous operating units. If you need more space, use the back of this page and write "11.b." next to your response.

c. Think about the actions the company has taken at your worksite since the March 23, 2005 explosion at the BP Texas City refinery. **Overall, how effective have the company's actions been** in protecting non-essential personnel in areas near hazardous operating units during their start-up or shutdown? Please mark one.

Very effective	**Somewhat effective**	**Somewhat ineffective**	**Very ineffective**	**Don't Know**
O	O	O	O	O

Section 5: Working on the Issues Covered In This Survey

Please keep the following in mind for the next two questions.

When we say, "local union," we mean members of the executive board, health and safety committee, health and safety representatives, shop stewards, etc.

When we say, "issues covered in this survey," we mean:

1. Use of a vent stacks on blow-down systems or other vent systems that could release untreated hazardous materials directly to the atmosphere (on process units only).
2. Management of instrumentation and alarm systems for start-up and shut-down.
3. Having trailers or other unprotected buildings near a processing unit where workers could be exposed to the release of hazardous materials, fires and explosions.
4. Allowing non-essential personnel to be in an area during the start-up of a processing unit containing highly hazardous materials.

12. a. Since the March 23, 2005 BP Texas City refinery explosion, has the **company taken the initiative to work with the local union** regarding the company's plans or actions related to the issues covered in this survey. For example has the company: informed the local union, involved the local union in assessing the problems, or involved the local union in making recommendations to solve the problems?

Yes	**No**
O	O

If you answered, **"No,"** please **skip to question 13** on the next page.

If you answered, **"Yes,"** please **continue with part b of this question** below.

b. Please use the box below to **describe the company initiatives to work with the local union on issues covered in this survey**. If you need more space, use the back of this page and write "12. b." next to your response.

13. a. Since the March 23, 2005 BP Texas City refinery explosion, has the **local union initiated action** to try to get the company to improve policies, training, procedures or conditions regarding the issues covered in this survey?

Yes	**No**
O	O

If you answered, **"No,"** please **skip to question 14** below on this page.

If you answered, **"Yes,"** please **continue with part b** of this question below.

b. Please use the box below to **describe the actions the local union initiated**. If you need more space, use the back of this page and write "13.b." next to your response.

14. Now we want to know about the **use of union workers to lead or direct work on process units** at your facility. If union workers are in these roles, they may have the job titles of head operator, chief operator, lead operator, Stillman, or some other title.

Please indicate the practice at your facility regarding the use of union workers to lead or direct work on process units? **Please check only one response choice** that best fits your experience.

O Union workers currently lead or direct work on process units.

O Union workers previously led or directed work on process units, but these positions were discontinued in the year _______.

O Union workers have never led or directed work on process units.

O Other. Please explain: ____

____

15. a. Since the March 23, 2005 BP Texas City refinery explosion, **approximately what percentage of the workforce at your worksite has the company trained** about preventing a catastrophic event involving the issues covered in this survey? Please indicate the approximate percentage below. If none, write "0%."

Training Issue	**Approximate % trained**	**Don't Know**
I. Use of atmospheric vents	______ %	O
II. Management of instrumentation and alarm systems	______ %	O
III. Trailers of other unprotected buildings near processing units	______ %	O
IV. Allowing non-essential personnel in hazardous area during start-up or shutdown	______ %	O

If you wrote, **"0%,"** or chose, **"Don't Know"** **<u>for all four issues,</u>** please **skip to question 16** below on this page. **Otherwise, continue with part b** of this question.

b. Please use the box below to **describe the training** the company conducted about preventing a catastrophic event involving the issues covered in this survey. Include **who was trained** and on **what subjects**. If you need more space, use the back of this page and write "15. b." next to your response.

16. Do members of the **bargaining unit need additional training** on the issues listed below?

Need training on issues?	**Yes**	**No**	**Don't Know**
I. Use of atmospheric vents	O	O	O
II. Management of instrumentation and alarm systems	O	O	O
III. Trailers of other unprotected buildings near processing units	O	O	O
IV. Allowing non-essential personnel in hazardous areas during start-up or shutdown	O	O	O

17. a. In the past three years, has your worksite had **any incidents or near misses involving issues covered in this survey**?

Any incidents or near misses in past three years?	**Yes**	**No**	**Don't Know**
I. Use of atmospheric vents	O	O	O
II. Management of instrumentation and alarm systems	O	O	O
III. Trailers of other unprotected buildings near processing units	O	O	O
IV. Allowing non-essential personnel in hazardous areas during start-up or shutdown	O	O	O

If you answered, **"No"** or **"Don't Know" to all four parts**, please **skip to Section 6** on the next page.

If you answered, **"Yes" to any part**, please **continue with part b of this question** below.

b. In the box below, please **describe any incidents or near misses** at your worksite **in the past three years** involving the issues covered in this survey that could have or did create a catastrophic event. Please include:

- **issue involved** (for example, vents, unprotected buildings or non-essential personnel in hazardous areas during start-up of shut-down)
- **number of people** involved (or potentially involved)
- **process units and chemicals**
- **types and sizes of releases** (or what was nearly released)
- **number and types of injuries** (or potential injuries)
- **other important details**, such as, investigations, results, company or union actions.

If you need more space, use the back of this page and write "17. b." next to your response.

Section 6: Emergency Preparedness and Response

18. a. Since the March 23, 2005 explosion at the BP Texas City refinery, **has the company taken actions** to improve your worksite's **preparedness to respond** safely to serious hazardous materials incidents or emergencies? Please mark one.

Yes	**No**	**Don't Know**
O	O	O

If you answered, **"No"** or **"Don't Know,"** please **skip to question 19** on the next page.

If you answered, **"Yes,"** please **continue with part b** below.

b. Using the box below, please **describe the company's actions** since March 23, 2005 to improve emergency preparedness and response. If you need more space, use the back of this page and write "18. b." next to your response.

c. How effective have the actions taken by the company been in improving your worksite's emergency preparedness and response? Please mark one.

Very effective	**Somewhat effective**	**Somewhat <u>in</u>effective**	**Very <u>in</u>effective**	**Don't Know**
O	O	O	O	O

19. This question is about **emergency response training**. Each worker should have a designated role in emergency response. Those roles may include reporting an incident, safely exiting the plant, or serving on a emergency response team, hazmat team or fire brigade. Each worker should receive **training appropriate to his or her role**.

Thinking now about the past 12 months, have workers at your site received **training on responding safely to serious hazardous materials incidents or emergencies**? Please **mark all that apply**.

Did group receive emergency response training in last 12 months?	**Yes**	**No**	**Don't Know**
Emergency response team, hazmat team or fire brigade	O	O	O
General plant population	O	O	O
Other group. Please specify: ______________________	O		
Other group. Please specify: ______________________	O		

20. Thinking about the workforce overall, **how confident are you that the workforce has received the training it needs** to respond safely to serious hazardous materials incidents or emergencies? Please mark one.

Very confident	**Somewhat confident**	**Somewhat <u>un</u>confident**	**Very <u>un</u>confident**
O	O	O	O

21. Overall, **how well prepared is your worksite to respond safely** to a serious hazardous materials incident or emergency? Please mark one.

Very prepared	**Somewhat prepared**	**Somewhat <u>un</u>prepared**	**Very <u>un</u>prepared**
O	O	O	O

Section 7: Process Safety Management Systems

22. The following series asks about the effectiveness of a range of **safety systems to prevent or respond** to a toxic or hazardous materials release, fire or explosion. **Thinking just about process start-ups and shutdowns, overall, how effective is each system** listed below?

Effectiveness of safety systems for process start-ups and shut-downs

Process Safety Management Systems	Very effective	Somewhat effective	Somewhat <u>in</u>effective	Very <u>in</u>effective	Don't know
a. **Design and engineering** (equipment, processes, software, instrumentation, etc.)	O	O	O	O	O
b. **Work organization and staffing levels**	O	O	O	O	O
c. **Managing the change of systems** (equipment, materials, processes, personnel, etc.)	O	O	O	O	O
d. **Inspection and testing**	O	O	O	O	O
e. **Relief and check valve systems**	O	O	O	O	O
f. **Systems for containing hazardous materials**	O	O	O	O	O
g. **Emergency shutdown and isolation systems**	O	O	O	O	O
h. **Fire and chemical suppression systems**	O	O	O	O	O
i. **Monitoring, and measurement systems** (temperature, pressure, volume, flow, level, etc)	O	O	O	O	O
j. **Alarm and notification systems**	O	O	O	O	O

Effectiveness of safety systems for process start-ups and shut-downs

Process Safety Management Systems	Very effective	Somewhat effective	Somewhat ineffective	Very ineffective	Don't know
k. Process Hazard Analyses (PHAs) (providing needed information for other safety systems)	O	O	O	O	O
l. Operating manuals and procedures	O	O	O	O	O
m. Training	O	O	O	O	O
n. Emergency preparedness and response	O	O	O	O	O
o. Communication systems within the plant	O	O	O	O	O
p. Communication systems for outside the plant (communities, emergency agencies, hospitals, etc.)	O	O	O	O	O

23. This question is about the overall **management of process safety systems** at your facility. These safety systems include design and engineering, maintenance and inspection, mitigation devices, warning devices, training and procedures, and personal protective factors. **Overall, how effective is the management of process safety systems** at your facility.

Very effective	Somewhat effective	Somewhat ineffective	Very ineffective
O	O	O	O

Section 8: Contract Workers

24. Approximately, what percentage of the workforce at your site that conducts either **routine maintenance** or **turnarounds and overhauls** fits into the following four categories?

- **a. contract** employees who are not members of a union
- **b. contract** employees who are members of a union other than USW
- **c. company** employees who are USW members, or
- **d. company** employees who are members of a union other than USW

Please indicate the approximate percentages below. If none for any category, write "0%." The percentages for each category going across should add up to 100%. Please tell us about any exceptions on the back side of this sheet and write "24" next to your response.

	Contract Employees		Company Employees		
	Other union	**Not union**	**USW members**	**Other union**	
Example	10 %	10 %	75 %	5 %	= 100%
Routine Maintenance Workers	______ %	______ %	______ %	______ %	= 100%
Turnaround or Overhaul Workers	______ %	______ %	______ %	______ %	= 100%

25. In this question, we want you to consider four groups of workers who may be at your work-site. **How well prepared** is each of the groups of workers listed below **to help prevent hazardous materials incidents**? Please mark one for each group.

	Very prepared	Somewhat prepared	Somewhat unprepared	Very unprepared	Don't Know	Does not apply
Routine maintenance workers						
Contract employees	O	O	O	O	O	O
Company employees	O	O	O	O	O	O
Turnaround or overhaul workers						
Contract employees	O	O	O	O	O	O
Company employees	O	O	O	O	O	O

Section 9: Background Information

26. What is your USW local union number? ____________

27. What is the name of the company that operates the plant where you work?

____

28. Please list the location of your worksite. City: ________________________ State: ____

29. Please use the box below to list the major products at your refinery?

30. What is the size of the workforce at your worksite? Please mark one.

O	O	O	O
0-99	100-499	500-999	1,000+

Thank you for completing this survey!

References

[1] U.S. Chemical Safety and Hazard Investigation Board (CSB). 2007. Investigation Report: Refinery Explosion and Fire (15 Killed, 180 Injured). BP, Texas City, Texas, March 23, 2005. Washington, D.C.: CSB. March 2007.

[2] OSHA. 2005. OSHA Fines BP Products North America More Than $21 Million Following Texas City Explosion. September 22, 2005. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=11589

[3] CSB. 2006. CSB Investigation of BP Texas City Refinery Disaster Continues as Organizational Issues Are Probed. Washington, D.C.: CSB. October 30.

[4] The CSB's findings from its investigation of the 2005 BP Texas City disaster specifically identified among causes the presence of a blowdown drum that released flammable, explosive, and toxic materials directly to the atmosphere. In its October 31, 2006 recommendations it noted, "A properly designed flare system would safely contain discharged liquid in a disposal drum and burn flammable vapor preventing a hazardous release to atmosphere. Flares are the most frequently used disposal control equipment in the oil refining industry." (p.1) Further, its October 31, 2006 recommendations on blowdown drums called for the American Petroleum Institute (API) to "change its Recommended Practice 521, Guide for Pressure Relieving and Depressurizing Systems, to end the practice of using these devices without inherently safe flare systems. Still further it noted, "OSHA publishes PSM Compliance Guidelines that establish procedures for the enforcement of the standard. These guidelines call for inspections to ensure that 'destruct systems such as flares are in place and operating' and 'pressure relieve valves and rupture disks are properly designed and discharge to a safe area.'"

See: CSB. 2005. CSB Issues Preliminary Findings in BP Texas City Refinery Accident; Investigators Present Data in Public Meeting. Washington, D.C.: CSB. October 27.

CSB. 2006. CSB's Safety Recommendations on Blowdown Drums to the American Petroleum Institute and OSHA. Houston, Texas, October 31, 2006. http://www.csb.gov/news_releases/docs/API-OSHA_Recommendation.pdf

[5] CSB. 2006. News conference statements Carolyn Merritt, Chairman, U.S. Chemical Safety Board. October 31, 2006. Washington, D.C.

[6] Baker J. et al. 2007. The Report of The BP U.S. Refineries Independent Safety Review Panel. http://www.safetyreviewpanel.com/. January 30, 2007.

[7] U.S. Department of Labor (DOL). 1990. Phillips 66 Houston Chemical Complex Explosion and Fire: Implications for Safety and Health in the Petrochemical Industry. Washington, D.C.: US DOL, OSHA.

[8] Belke J. 2000. U.S. Environmental Protection Agency. "Chemical accident risks in U.S. industry: A preliminary analysis of accident risk data from U.S. hazardous facilities." September 25, 2000.

[9] Key landmines on this trail of process safety disasters include those at BP Flixborough, UK (1974); Industrie Chimiche Meda Societa Azionaria, Seveso, Italy (1976); Union Carbide in Bhopal, India (1984) and Institute, West Virginia (1985); and Phillips 66 in Texas (1989).
See: Health and Safety Executive (HSE). 2006. Flixborough (Nypro UK) Explosion 1st June 1974. http://www.hse.gov.uk/comah/sragtech/caseflixboroug74.htm. Health and Safety Executive (HSE). 2006. Icmesa chemical company, Seveso, Italy. 9th July 1976. http://www.hse.gov.uk/comah/sragtech/caseseveso76.htm. Health and Safety Executive (HSE). 2006. Union Carbide India Ltd, Bhopal, India. 3rd December 1984. http://www.hse.gov.uk/comah/sragtech/caseuncarbide84.htm. United Press International. 1985. OSHA cites Union Carbide with neglecting safety policy. Houston Chronicle, October 1, 1985.

[10] OSHA (Occupational Safety and Health Administration). 1994. Hazardous Waste Operations and Emergency Response. Final Rule. 29 CFR 1910.120. Federal Register, August 22, 1994 (59 FR 43268).

[11] OSHA (Occupational Safety and Health Administration). 1992. Process Safety Management of Highly Hazardous Chemicals. 29 CFR 1910.119. Fed Reg 57:6403.

[12] EPA. 1996. Accidental Release Prevention Requirements: Risk Management Programs Under the Clean Air Act, Section 112(r)(7), 40 CFR Part 68, Final Rules and Notice, 61 FR 31668, June 20, 1996.

[13] These include: Organisation for Economic Co-operation and Development's (OECD's)* Guiding Principles for Chemical Accident Prevention, Preparedness and Response and its related Guidance on Safety Performance Indicators, and European Seveso Directive II and its related Guidelines on a Major Accident Prevention Policy and Management Systems. More generally, the American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA) standard on Occupational Health and Safety Management Systems and the International Labour Organisation's (ILO's) Guidelines on Occupational Health and Safety Management Systems provide additional, broader guidance.

*The OECD is an international organization of 30 developed countries including the U.S. that "produces internationally agreed instruments, decisions and recommendations to promote rules of the game in areas where multilateral agreement is necessary for individual countries to make progress in a globalised economy," using, "dialogue, consensus, peer review and pressure." (http://www.oecd.org/about/0,2337,en_2649_201185 _1_1_1_1_1,00.html)

See:

OECD. 2003. OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response: Guidance for Industry (including Management and Labour), Public Authorities, Communities, and other Stakeholders (Second Edition). Paris, France: OECD Environmental, Health and Safety Publications.

OECD. 2005. Guidance on Safety Performance Indicators: Guidance for Industry, Public Authorities and Communities for Developing SPI Programmes related to Chemical Accident Prevention, Preparedness and Response. Paris, France: OECD Environmental, Health and Safety Publications.

Council Directive of 9 December 1996, On The Control Of Major-Accident Hazards Involving Dangerous Substances, (96/82/EC) Official Journal of the European Communities No L 10, 14.1.1997, pp. 13-33.

European Communities. 1998. Guidelines on a Major Accident Prevention Policy and Safety Management System, as required by Council Directive 96/82/EC (Seveso II) in Mitchison N, Porter S (Eds), Luxembourg: Office for Official Publications of the European Communities, 1998.

American Industrial Hygiene Association (AIHA). 2005. Occupational Health and Safety Management Systems. ANSI/AIHA Z10-2005. Fairfax, VA: AIHA. (ANSI/AIHA—American National Standards Institute/American Industrial Hygiene Association.)

ILO-OSH. 2001. Guidelines on Occupational Health and Safety Management Systems. Geneva, Switzerland: ILO, 2001. <http://www.ilo.org/public/english/support/publ/xtextoh.htm>.

[14] Rosenthal I, Kleindorfer PR, Elliot M. 2006. Predicting and Confirming the Effectiveness of Systems for Managing Low-Probability Chemical Process Risks. American Institute of Chemical Engineers Process Safety Progress (Vol.25, No.2)

[15] CSB. 2005. CSB Issues Preliminary Findings in BP Texas City Refinery Accident; Investigators Present Data in Public Meeting. Washington, D.C.: CSB. October 27.

[16] Organisation for Economic Co-operation and Development. 2005. Report of the OECD Workshop on Lessons Learned from Chemical Accidents and Incidents (21-23 September 2004, Karlskoga, Sweden), OECD Environment, Health and Safety Publications Series on Chemical Accidents NO. 14. Environmental Directorate OECD. Paris, France.

[17] Senge, PM. 1990. The fifth discipline: the art and practice of learning organizations. New York: Doubleday.

[18] Argyris, C, Schön, DA. 1996. Organizational Learning II. New York: Addison-Wesley Publishing Co.

[19] Marais K, Dulac N, Leveson N. 2004. Beyond Normal Accidents and High Reliability Organizations: The Need for an Alternative Approach to Safety in Complex Systems. Paper presented at the Engineering Systems Division Symposium, MIT. Cambridge, MA. March 29-31.

[20] EPA and OSHA. 1998. EPA/OSHA Joint Chemical Accident Investigation Report – Shell Chemical Company, Deer Park, Texas. EPA 550-R-98-005, U.S. Environmental Protection Agency.

[21] Health and Safety Executive (HSE). 2003. Major Incident Report Investigation, BP Grangemouth Scotland. Health and Safety Executive, London, August 18, 2003. The United Kingdom's Health and Safety Executive is the functional equivalent of U.S. OSHA.

[22] The OSHA/EPA 1998 report recommended that:

> The Shell Chemical Company and other companies that process flammable gases and volatile flammable liquids or liquefied gases must implement precautionary measures contained in OSHA's PSM standard and EPA's RMP rule to prevent flammable gas leaks from resulting in vapor cloud explosions. (p. v)
>
> Lessons learned from prior incidents involving [similar] … check valves … were not adequately identified, shared, and implemented. This prevented recognition and correction of the valve's design and manufacturing flaws … prior to the accident. (p. iii)
>
> The process hazards analysis (PHA) … was inadequate; the PHA did not identify the risks …, and consequently no steps were taken to mitigate those risks. (p. iii)

[23] EPA. 1998b. EPA Chemical Accident Investigation Report: Tosco Avon Refinery, Martinez, California. United Stated Environmental Protection Agency, Office of Solid Waste and Emergency Response (5104). EPA 550-R-98-009. November 1998.

[24] CSB. 2001. Management of Change. U.S. Chemical Safety and Hazard Investigation Board Safety Bulletin. No. 2001-04-SB, August 2001

[25] EPA's 1998 Tosco report recommended:

> Facilities should maintain equipment integrity and discontinue operation if integrity is compromised. (p. x)
>
> Industry in general, should examine the process parameters that are critical to safe operation and consider redundant instrumentation as a backup in case of instrument malfunction.
>
> Other industries should examine their process monitoring and control instrumentation to ensure that in emergency or upset situations, control room operators are appropriately notified of the status of critical parameters so the operator can take necessary steps to correct the situation. Safety critical alarms should be distinguished from other operational alarms. Alarms should be limited to the number that an operator can effectively monitor. However, ultimate plant safety should not solely rely on operator response to a control system alarm. (p. 72)

[26] The 2001 CSB report noted:

> Had the limitations of temperature-sensing devices been better understood, personnel may have realized that the low temperature readings were not representative of the hot core. It was assumed that the entire drum contents had cooled to safe levels …. (pp. 2-3)

[27] The 2003 HSE report recommended:

> The emergency shutdown of the 'light ends' section of the FCCU … (in particular the following): a) Installation of remotely operated shut-off valves (ROSOVs) to allow rapid remote isolation of significant process inventories in order to minimise the consequences of an uncontrolled leak and allow remote emergency shutdown of ancillary equipment, such as pumps. b) Safe means for emergency depressurisation of columns or vessels, where reasonably practicable. (p. 53)

[28] EPA. 1998a. EPA Chemical Accident Investigation Report: Pennzoil Product Company Refinery Rouseville, Pennsylvania. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response (5104), EPA 550-R-98-001, March 1998.

[29] The 1998 EPA Tosco report recommendations included the statement:

> Facilities should use hazard assessment techniques to address the hazards associated with vehicular access and location of temporary work trailers in the vicinity of storage vessels. (p. iii)

[30] The EPA in its Pennzoil report recommended the following related to facility siting:

> PHA techniques can be used to evaluate the hazards associated with siting of equipment and work areas. Pennzoil and the other facilities can make use of these techniques in combination with industry codes and standards and regulatory requirements, to ensure that vehicular traffic is restricted from areas containing flammable materials, that work locations are properly evalu-

ated and isolated from potential process hazards and that these work locations do not impose hazards on the process (ignition sources). Further, accident history, the potential for leaks, spills, and vessel failures should be evaluated to determine the need for secondary containment or other impoundment as a means of preventing impact on other site areas. (pp. 22-23)

[31] CSB. 2005. CSB Issues Urgent Recommendations to U.S. Petrochemical Industry, Calls for Safer Placement of Trailers for Workers in Wake of BP Tragedy. CSB News Release. Washington, DC, October 25.

[32] USFA/DHS, 2004. Hazardous Materials and Terrorist Incident Prevention Curriculum Guidelines. www.usfa.dhs.gov/downloads/pdf/publications/hmep9-1801prevention.pdf

[33] NIEHS, 2006. Minimum Health and Safety Training Criteria: Guidance for Hazardous Waste Operations and Emergency Response (HAZWOPER), HAZWOPER-Supporting and All-Hazards Disaster Prevention, Preparedness & Response. Workshop Report. January 2006. Washington, D.C.: National Clearinghouse for Worker Safety and Health Training. (www.wetp.org)

[34] John Gray Institute. 1991. Managing Workplace Safety and Health: The Case of Contract Labor in the U.S. Petrochemical Industry. Beaumont, Texas: Lamar University.

[35] Israel BA, Checkoway B, Schulz A, Zimmerman M. 1994. Health education and community empowerment: conceptualizing and measuring perceptions of individual, organizational and community control. Health Education Quarterly 21:149–170.

[36] McQuiston TH. 2000. Empowerment evaluation of worker safety and health education programs. American Journal of Industrial Medicine 38:584–597.

[37] Lippin TM, McQuiston TH, Bradley-Bull K, Burns-Johnson T, Cook L, Gill ML, Howard D, Seymour TA, Stephens D, Williams BK. 2006. Chemical Plants Remain Vulnerable to Terrorists: A Call to Action. Environmental Health Perspectives, 114:1307–1311.

[38] All figures based on “Total Operable Capacity - Atmospheric Crude Distillation Capacity” (barrels per calendar day). Refinery Capacity Data by individual refinery as of 01/01/2005. DOE Energy Information Administration.
http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/refinery_capacity_data/data/refcap05.xls

[39] The phrase “atmospheric vents” when used in the USW Refinery Accident Prevention Survey and this report refers only to vents on process units (not those on tank farm vessels) and is limited to atmospheric vent stacks on blow-down systems, or other vent systems that could release untreated flammable, explosive, reactive, toxic, or otherwise hazardous materials directly to the atmosphere.

The phrase “management of instrumentation and alarm systems” when used in the USW Refinery Accident Prevention Survey and this report refers to all instrumentation, including level indicators and alarms, that would signal any abnormal or emergency conditions during process start-ups or shutdowns.

The phrase “trailers or other unprotected buildings inside potentially hazardous areas,’’ when used in the USW Refinery Accident Prevention Survey and this report refers to those buildings where people work, meet, or congregate, and the siting of buildings in high hazard or vulnerability zones where occupants could be exposed to fires, explosions, or releases of toxic or hazardous materials.

The phrase “non-essential personnel in vulnerable areas during process start-up or shutdown” when used in the USW Refinery Accident Prevention Survey and this report refers to having non-essential personnel in areas where they could be vulnerable to a toxic or hazardous materials release, fire, or explosion during a process start-up or shutdown.

[40] Process units with atmospheric vents included: 42% on fluidized catalytic cracking units (FCCUs); 36% on crude units; 12% on coker units; and 32% on other types of process units. A sampling of other types of process units with atmospheric vents included: hydrocarbon distillation, furfural (furfuraldehyde), and cumene (isopropylbenzene) units.

[41] The locations reported for trailers and other unprotected buildings included: fluidized catalytic cracking, coker, crude, alkylation, isomerization, acid, hydrocracking, and distillation. Respondents’ descriptions of locations for trailers and other unprotected buildings included: outside central control, scores and scores of trailers placed anywhere throughout the refinery, within 100’ of process equip-

ment during start-up and shutdown, and various units for turnaround. Their descriptions of potential hazards in the vicinity of trailers and unprotected buildings included extreme flammability, explosion, benzene, methane, naphtha, hydrogen sulfide, sour water, butanes, propane, hydrogen, etc.

42 Examples of initiatives in the survey question included the company informing the local union, involving the local union in assessing the problems, or involving the local union in making recommendations to solve the problems.

43 See CSB. 2007. See pp. 20-21, 195-202.

44 The CSB in its 2007 Report (see 1 above) noted its previously issued recommendations including item 1.7.2.2 Trailer Siting Recommendtions:

> On October 25, 2005, the CSB issued two urgent safety recommendations. The first called on the American Petroleum Institute (API) to develop new guidelines to ensure that occupied trailers and similar temporary structures are placed safely away from hazardous areas of process plants; API agreed to develop new guidelines. A second recommendation to API and the National Petrochemical and Refiners Association (NPRA) called for both to issue a safety alert urging their members to take prompt action to ensure that trailers are safely located. API and NPRA published information on the two recommendations, referring to the CSB's call for industry to take prompt action to ensure the safe placement of occupied trailers away from hazardous areas of process plants.

45 The CSB in its 2007 Report (see 1 above) noted its previously issued recommendations including item 1.7.2.3 Blowdown Drum and Stack Recommendations:

> On October 31, 2006, the CSB issued two recommendations regarding the use of blowdown drums and stacks that handle flammables. The CSB recommended that API revise "Recommended Practice 521, Guide for Pressure Relieving and Depressuring Systems," to identify the hazards of this equipment, to address the need to adequately size disposal drums, and to urge the use of inherently safer alternatives such as flare systems.
>
> The CSB issued a recommendation to OSHA to conduct a national emphasis program for oil refineries focused on the hazards of blowdown drums and stacks that release flammables to the atmosphere and on inadequately sized disposal drums. The CSB further recommended that states that administer their own OSHA plan implement comparable emphasis programs within their jurisdictions.

46 U.S. Chemical Safety Board. 2006. CSB Releases Trailer Blast Damage Information from BP Texas City Accident. CSB News Release. Washington, DC, June 30, 2006. http://www.csb.gov/index.cfm?folder=news_releases&page=news&NEWS_ID=301.

47 CSB, October 25, 2005. The CSB's recommendation called on the American Petroleum Institute (API) to revise its Recommended Practice 752, "Management of Hazards Associated with Location of Process Plant Buildings" or issue a new Recommended Practice to ensure the safe placement of occupied trailers and similar temporary structures away from hazardous areas of process plants. It also called on API and the National Petrochemical and Refiners Association (NPRA) to Issue a safety alert to their membership to take prompt action to ensure the safe placement of occupied trailers away from hazardous areas of process plants. In it's 2007 report, the CSB noted that "API and NPRA published information on the two recommendations, referring to the CSB's call for industry to take prompt action to ensure the safe placement of occupied trailers away from hazardous areas of process plants." (p. 28)

48 API. 2003. Management of Hazards Associated with Location of Process Plant Buildings: API Recommended Practice 752. (2nd Edition). Washington, D.C.: API Publishing Services.

49 The following list was developed in large part by a team of USW refinery workers in developing curriculum on pre-start-up safety reviews (PSSRs). At a minimum, these reviews must certify that: a) all process hardware, software, and procedures are fully operational and sufficient for all foreseeable conditions including those that may be unique to start-ups, shutdowns, or emergencies; b) all hardware and piping have been direct examined to ensure that all lockout/tagout procedures have been successfully closed out and locks and tags removed; c) non-destructive testing of all lines has been undertaken including pressure testing and mechanical inspection of all gaskets and bolts; d) all management of change (MOC) reviews and actions have been completed including training for all persons

affected; e) start-up is aborted if there are more than three deviations; f) operating procedures match the condition of the process (i.e., account for variations in conditions following normal or emergency shutdowns); g) a dry run of start-up procedures has been performed; and h) community and emergency response agencies have been informed of impending start-up or shutdown.

[50] Written operating procedures must provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information and include steps for each operating phase; normal, temporary and emergency operations including start-ups and shut-downs; operating limits including avoidance of, consequences and corrections for deviations; safety and health considerations and exposure prevention.

[51] HSE, 2006. Managing Shiftwork. U.K. HSE Books.

[52] Center for Chemical Process Safety (CCPS). 2007. Guidelines for Measuring Process Safety Progress. American Institute of Chemical Engineers (AIChE): http://www.aiche.org/ccps/activeprojects/Pj192.aspx

[53] USW and BP. 2007. USW BP Joint Initiative On Health And Safety. USW: Pittsburgh, PA.