

CSB Case Study Cites Deficient Management Systems, Inadequate Safeguards in Gnadenuhuten, Ohio, Explosion and Fire

Investigators from the U.S. Chemical Safety Board (CSB) have concluded that an explosion and fire at Catalyst Systems Inc. in Gnadenuhuten, Ohio, last January most likely occurred when 200 pounds of benzoyl peroxide in a vacuum dryer rapidly decomposed. The runaway chemical reaction produced large volumes of gas under high pressure. Presenting their findings in the form of a case study to the five-member CSB Board in Washington, DC, today, investigators said they were unable to determine the specific initiating event that led to the thermal decomposition, in which a chemical breakdown produces heat that leads to further breakdown. But the study noted the likely underlying cause of the accident was that management had not put in place a proper hazard identification system.

The force of the explosion propelled the heavy vacuum dryer like a rocket across the room and through a wall, causing extensive damage to the building, but missing workers eating lunch just 35 feet away in the same room. The operators described thick black smoke with rolling flames and a loud boom. They quickly exited the building. One worker received a puncture wound in his shoulder, most likely from flying debris. CSB Board Chairman Carolyn Merritt said: "The workers were fortunate they were not standing by the vacuum dryer at the time of the explosion. This is another example of the dangers of not recognizing the inherent hazards of materials being handled, not using properly designed equipment, and not performing hazard identification studies. We noted this in our major report on reactive hazards last year, and I remain determined to continue our work focusing the industry on these hazards. Small businesses also need to know they must follow safe handling practices." The purpose of the process was to concentrate benzoyl peroxide, or BPO, to 98 percent by drying it. In this form BPO is the consistency of beach sand, and can decompose explosively when overheated. BPO is used to make a number of products, including plastics, silicone rubber, and automobile body putty.

The process, involving highly reactive materials, was not sufficiently evaluated by management, the study said, adding that Catalyst Systems had no program to formally take the hazards, generally well known in the industry, into account in the design of the dryer. The study found the dryer had been purchased second-hand, with no wiring diagram or engineering drawings. No written operating procedures were developed for drying the chemical – only verbal instructions were provided operators. Lead investigator Lisa Long said: "The accident might have been avoided had the company evaluated the potential hazards in their process and used this information to design appropriate safeguards into the drying process."

The case study notes that management systems – including explicit, detailed procedures and practices and clear statements of accountability for implementing the procedures and practices -- are vital for preventing catastrophic accidents, particularly where hazardous materials are used. Management systems are developed after considering a range of information, including the hazardous properties of chemicals and equipment design. The case study says, "Catalyst Systems did not have a process safety management program in place, nor were employees trained in the use of these systems." While not determining the specific initiating event of the explosion, the study listed several probable sources. These included failure of a temperature probe, a hot spot in the dryer, failure of the vacuum pump, and leaving the chemical in the dryer too long.

The CSB is an independent federal agency charged with investigating industrial chemical accidents. CSB investigations look into all aspects of such events, including physical causes such as equipment failure as well as inadequacies in safety management systems. Typically, the investigations involve extensive witness interviews, examination of physical evidence, and chemical and forensic testing. The Board does not issue citations or fines but does make safety recommendations to plants, industry organizations, labor groups, and regulatory agencies such as OSHA and EPA. Further information about the CSB is available from www.csb.gov.

U.S. Chemical Safety Board (CSB) have concluded that the October 2002 plant explosion here occurred because First Chemical Corporation had not effectively evaluated the hazards of a chemical process that ran out of control.

The blast blew the top off a distillation tower that was approximately 145 feet tall and propelled tons of fiery debris in the air, raining down onto adjacent industrial facilities and narrowly missing nearby hazardous chemical tanks. The investigators' report, which will be presented and voted on at a public meeting of the five-member Board today, said that plant operators were unaware that a dangerous chemical reaction was taking place inside the tower.

The process involved mononitrotoluene or MNT, a chemical related to TNT that can be explosive when exposed to high temperatures. Operators thought the process had been shut down weeks earlier, with all sources of heat removed. Unrecognized by plant personnel, the valves used to shut off steam to the tower had deteriorated. Steam was leaking through the shut-off valves, heating the 1,200 gallons of MNT in the column to a critical temperature of over 450°F, initiating a violent reaction as the material decomposed.

The tower exploded at 5:25 a.m. on Sunday, October 13, 2002. Three plant employees were injured when glass windows shattered into the control room where they were working. The CSB report said the room was located too close to the MNT tower and was not reinforced to withstand blast pressure. A projectile from the explosion pierced an MNT storage tank some distance away, igniting a fire that burned for almost three hours. Other debris landed a few feet from a large cylinder of anhydrous ammonia without doing serious damage. Area residents were directed to seek shelter in their homes, though the CSB learned at a public meeting later that this direction was not effectively communicated to them. Additionally, residents were not aware of the appropriate action to take while they sought shelter.

Board member Dr. Gerald Poje, chair of today's meeting, said, "We are very fortunate that shrapnel from the tower did not cause a greater chemical release or a more damaging fire. This accident underscores once again the vital importance of properly managing dangerous reactive chemicals and the processes that use them. When the Board voted last September to recommend that EPA and OSHA strengthen their regulations to reduce such dangers, we hardly imagined such a dramatic demonstration of the need would occur just three weeks later."

In a report presented in September 2002 the CSB noted significant gaps in regulatory coverage of reactive chemicals. The CSB Board called on the U.S. Occupational Safety and Health Administration (OSHA) and the U.S. Environmental Protection Agency (EPA) to expand the regulatory coverage of reactive chemicals and mixtures under their process safety rules. Those rules specify various safety measures for chemical processes – such as performing hazard analyses, safety audits, and preventive maintenance. However, at

present only a limited number of chemicals trigger such coverage. OSHA and EPA have yet to act on the Board's 2002 rulemaking commendation, and existing regulations do not cover MNT.

Stephen J. Wallace, CSB lead investigator, said, "The plant did not have adequate systems for evaluating the hazards of processing MNT." He added that "First Chemical had learned of the instability of MNT during a safety analysis of a similar unit in 1996 but had not applied those safety lessons to the process that exploded – a root cause of the blast." Mr. Wallace also noted that the facility did not have an effective program for maintaining critical process equipment like the steam shut-off valves. The report further found that the plant did not have adequate systems to warn operations personnel of unexpected temperature increases, one sign of a runaway chemical reaction. Nor were there systems to automatically bring the process back to a safe state. Column C 501 – the tower used to distill MNT – had no temperature alarms, no automatic shutoff of the heating source, and no adequate system to relieve pressure build-up and mitigate the effects of an explosion.

The report proposes several recommendations be directed to the Pascagoula facility and the DuPont Corporation, which purchased First Chemical after the accident: that the facility improve its hazard analyses, conduct process safety audits, and install appropriate warning devices, and that DuPont Corporation track the facility's progress. In addition, the report recommends Jackson County improve its community notification system for such emergencies.

The CSB also recommended that the American Chemistry Council (ACC) and the Synthetic Organic Chemical Manufacturers Association (SOCMA) improve their industry management code, known as Responsible Care, under which member companies agree to comply with various safety policies. The report found that First Chemical Corporation, a SOCMA member at the time of the accident, had earlier asserted to SOCMA that it was following those agreed-upon safety policies – including performing hazard analyses – even though no evaluation had been done for the MNT unit.

The CSB is an independent federal agency charged with investigating industrial chemical accidents. CSB investigations look into all aspects of such events, including physical causes like equipment failure, as well as inadequacies in safety management systems. Typically, the investigations involve extensive witness interviews, examination of physical evidence, and chemical and forensic testing. The Board does not issue citations or fines but does make safety recommendations to plants, industry organizations, labor groups, and regulatory agencies such as OSHA and EPA. Further information about the CSB is available from www.csb.gov.

CSB Issues Final Report On Chelsea Building Explosion, Calls On New York City To Strengthen Fire Code

The U.S. Chemical Safety and Hazard Investigation Board (CSB) today recommended that New York City modernize its 85-year-old municipal fire code, concluding that a stronger code and better inspections might have prevented last year's building explosion in Chelsea. That blast on April 25, 2002, injured 36 people, including 14 members of the public and six firefighters.

The CSB found that the accident at Kaltech Industries, a commercial sign manufacturer, resulted from mixing two incompatible waste chemicals, lacquer thinner and nitric acid,

without following basic safety requirements. The full five-member CSB Board was expected to approve the report and issue the recommendations at a public meeting in New York City today. The report calls on the Mayor and City Council of New York to revise the Fire Prevention Code to "achieve more comprehensive control over the storage and use of hazardous materials." CSB Chairman Carolyn Merritt stated: "Hazardous materials need to be identified, labeled, and managed under an approved plan. Incompatible materials need to be separated. Finally, workers need to be trained in their own language and provided with material safety data sheets that indicate known hazards. These measures, most of which are already part of model fire codes, will go a long way toward preventing future chemical accidents in New York City." The CSB report also recommends changes to federal

and New York state inspection programs. The Board is also expected to recommend that if a building houses businesses that use hazardous materials, the building should be required to develop a hazardous materials safety plan and designate an individual to ensure the plan is implemented. Tenant businesses that store or use hazardous materials should be required to provide critical information to assist in the development of that plan. CSB investigators found two root causes at the heart of the Kaltech accident. First, company management did not provide workers with sufficient information about the hazardous chemicals stored and used there. Second, the company was not in compliance with several important waste disposal requirements. The report cited as contributing factors the lack of sufficient chemical safety precautions in the New York City fire code and the failure of government inspections to detect unsafe practices at Kaltech.

CSB lead investigator Steve Selk said that government authorities have an opportunity to prevent such tragic occurrences. "Smaller businesses sometimes aren't aware of required practices for handling hazardous materials," Mr. Selk said. "Routine inspection and enforcement by local and state authorities is one way that businesses learn about good safety practices – before an accident occurs." City fire inspectors had visited Kaltech about once a year but did not inspect the basement where the hazardous chemicals were stored, according to the report.

Neither the New York State Department of Environmental Conservation nor the U.S. Occupational Safety and Health Administration (OSHA) had ever inspected the facility. Chairman Merritt said, "Explosions like this can happen again if local businesses are not inspected by fully trained inspectors armed with modern codes and standards for hazardous materials. There are likely thousands of similar businesses that use chemicals around the city and the nation, with varying levels of safety practice." The New York City fire code has not been comprehensively revised since it was first adopted in 1918. Unlike more modern codes, such as the National Fire Protection Association (NFPA) Code and the International Fire Code (IFC), the New York City code lacks up-to-date provisions for the safe handling of hazardous materials. By state law, all New York jurisdictions except New York City follow a modified version of the International Fire Code. At an April 2003 CSB field hearing in New York City, municipal officials acknowledged deficiencies in the existing city fire code. As one official testified, "It appears that select model codes are more complete in scope and breadth as compared to the current New York City Fire Prevention Code."

Kaltech Industries Group made commercial signs and used hazardous chemicals to etch and clean metal. Kaltech was located in the basement, mezzanine, and part of the first floor at 123 West 19th Street, in a building that also housed service firms, professional offices, and other businesses. The explosion originated in the basement, causing

extensive damage there, and spread up through an elevator shaft and a stairwell, shattering street-front windows on the first five floors of the ten-story brick structure. The building façade was partially destroyed and collapsed into 19th Street.

The CSB is an independent federal agency charged with investigating industrial chemical accidents. CSB investigations look into all aspects of such events, including physical causes such as equipment failure as well as inadequacies in safety management systems. Typically, the investigations involve extensive witness interviews, examination of physical evidence, and chemical and forensic testing. The Board does not issue citations or fines but does make safety recommendations to plants, industry organizations, labor groups, and regulatory agencies such as OSHA and EPA. Further information about the CSB is available from www.csb.gov.

CSB Investigators Cite Lack of Effective Management Systems in Hydrogen Sulfide Incident at Cincinnati Waste Disposal Plant

A release of potentially deadly hydrogen sulfide (H₂S) at the Environmental Enterprises Inc. (EEI) waste treatment facility in Cincinnati, Ohio, resulted from treating chemical wastes in an inappropriate vessel, according to investigators from U.S. Chemical Safety and Hazard Investigation Board (CSB) speaking today at a Board public meeting.

CSB lead investigator Angela Blair stated, "Management systems are the key to preventing this kind of incident," noting that a combination of problems contributed to the event. The incident, which occurred December 11, 2002, caused a maintenance worker to collapse after he walked near the waste vessel and inhaled toxic hydrogen sulfide, which carries a signature rotten egg odor. Inhaling the gas can cause accumulation of fluid in the lungs and respiratory arrest. The victim, who was initially unable to breathe, was treated at a local hospital and released. "Environmental Enterprises had not adequately trained its employees on the hazards of hydrogen sulfide," according to CSB investigator Johnnie Banks. "Therefore the employees did not recognize the rotten egg odor as a sign of imminent danger."

EEI treats water-based hazardous waste containing various contaminants, including heavy metals, for disposal. CSB investigators said the hydrogen sulfide release occurred after an operator added solid sodium sulfide to a batch of waste in an effort to remove mercury. Later the same operator added an acidic chemical (polyaluminum chloride) to adjust the pH of the waste. Unknown to the operator, excess sodium sulfide reacted with the acidic chemical to form hydrogen sulfide gas, which was released from the open-top clarifier vessel where the treatment was attempted. Later the maintenance worker entered the treatment area, which was then unattended, to retrieve a tool when he was overcome by the gas.

The clarifier was not designed to handle the possibility of toxic gas formation and had no equipment to collect and treat such gases. "This is the second serious incident we have investigated recently where the reaction of a sulfide salt with acid produced a dangerous gas release," according to CSB Chairman Carolyn W. Merritt. In November 2002 the Board completed its investigation of an incident at an Alabama paper mill where two workers were killed and eight others injured when a similar reaction in a process sewer caused a release of hydrogen sulfide gas. "Clearly there is a strong need for greater awareness of the hazards of reactive sulfides," Merritt said.

The CSB investigators found the EEI incident could have been avoided if workers had been trained on hydrogen sulfide hazards, had been given appropriate written procedures for performing treatment operations, or had been informed about the requirements of an earlier city order to abate hydrogen sulfide hazards at the plant. A hydrogen sulfide warning device, installed under provisions of the city order, was not working at the time of the December 11 incident.

The CSB is an independent federal agency charged with investigating industrial chemical accidents. CSB investigations look into all aspects of such events, including physical causes such as equipment failure as well as inadequacies in safety management systems. Typically, the investigations involve extensive witness interviews, examination of physical evidence, and chemical and forensic testing. The Board does not issue citations or fines but does make safety recommendations to plants, industry organizations, labor groups, and regulatory agencies such as OSHA and EPA. Further information about the CSB is available from www.csb.gov.

Lack of Hazard Recognition, Unsafe Handling of Flammable Liquids Caused BLSR Fire

Last January's deadly fire at an oilfield waste disposal facility south of Houston could have been avoided if the companies involved had safer procedures for handling flammable wastes, investigators from the U.S. Chemical Safety and Hazard Investigation Board (CSB) reported today in a public meeting. The January 13 accident in Rosharon, Texas, occurred as two tank trucks unloaded waste liquids into an open collection pit at the BLSR Operating Ltd. disposal facility. Unknown to either the drivers or BLSR personnel, the waste material was highly volatile, and a flammable vapor cloud formed in the unloading area. Vapor was drawn into the air intakes of trucks' running diesel engines -- causing them to race and backfire -- and the flammable cloud ignited. Two BLSR employees standing near the trucks were killed in the fire, and three others suffered serious burns.

The two drivers, who were employed by T&L Environmental Services Inc., were also burned after rushing back to their trucks when they heard the engines accelerate. One of the drivers died several weeks later from his injuries. Board Chairman Carolyn Merritt said, "This accident, which took three lives and caused devastating burns to survivors, could have been prevented if the hazard of the waste had been recognized, communicated, and controlled. Oil and gas field wastes can be highly flammable and need to be handled appropriately. It's my hope that our findings and recommendations will be widely reviewed by similar operations, helping save lives in the future."

CSB lead investigator John Vorderbrueggen pointed to two root causes that led to the tragedy. First, the producer of the waste, Noble Energy, did not recognize its potential flammability nor did it provide appropriate safety information to either T&L or BLSR. This liquid waste, referred to as basic sediment and water, or BS&W, settles to the bottom of storage tanks that contain either crude oil or the liquid hydrocarbons that condense from natural gas (gas condensate). BS&W is commonly sent to deep-well injection sites for disposal. But the material can contain significant quantities of flammable hydrocarbons.

When tested, most samples of BS&W obtained by Board investigators were found to be highly flammable, including material from the Noble Energy storage tanks involved in the incident. "Material safety data sheets -- documents that describe materials and hazards in detail -- should have been prepared by the waste producer and provided to the truck drivers and the disposal facility operators," Mr. Vorderbrueggen said. "Equipped with that

information, each party can understand and manage the hazard." The Material Safety Data Sheets (MSDSs) are required for hazardous substances under regulations of the U.S. Occupational Safety and Health Administration (OSHA). The second root cause of the accident was that BLSR management did not have safe unloading and handling practices for potentially flammable BS&W wastes.

Not recognizing the hazards of the material, the company did not control potential ignition sources or use unloading techniques designed to minimize vapor formation. Among the contributing causes cited in the report: T&L management did not require oilfield waste generators to provide its truck drivers with MSDSs indicating material hazards. Neither T&L nor BLSR followed relevant safe operating practices recommended by the American Petroleum Institute (API), a prominent industry trade organization. Vorderbrueggen said that the safety recommendations contained in the report, if widely implemented, will help prevent future accidents involving oilfield wastes. The report called on the Texas Railroad Commission, which regulates oilfield operations in the state, to require all drillers and producers to comply with federal regulations on communicating hazards to workers and safely transporting hazardous liquids. Another recommendation requested that OSHA and the U.S. Department of Transportation each issue a special bulletin on the flammability hazards of oilfield wastes. The report also made a variety of individual recommendations to Noble Energy, BLSR, and T&L concerning safe practices and procedures for flammable waste handling.

The CSB is an independent federal agency charged with investigating industrial chemical accidents. CSB investigations look into all aspects of such events, including physical causes such as equipment failure as well as inadequacies in safety management systems. Typically, the investigations involve extensive witness interviews, examination of physical evidence, and chemical and forensic testing. The Board does not issue citations or fines but does make safety recommendations to plants, industry organizations, labor groups, and regulatory agencies such as OSHA and EPA. Further information about the CSB is available from www.csb.gov.

CSB Board Votes 5-0 to Approve Report on DPC Chlorine Release, Calls for Industry-Wide System for Hose Identification

The U.S. Chemical Safety Board today approved its final report and recommendations on the accident and called for industry-wide measures to improve chlorine safety. Meeting before a public audience that included residents, emergency responders, and company officials, the Board accepted the draft investigative report of its staff and also issued a new recommendation that state agencies convene a review of the health and environmental concerns voiced today by residents. About 100 community members and others attended this morning's meeting in Festus. The final report of the Board will be available later in May from the agency's web site, www.csb.gov.

The August 14, 2002, release of 48,000 pounds of chlorine from DPC Enterprises caused 63 people from the surrounding community to seek medical evaluation. Some residents at today's meeting offered harrowing accounts of the event and said they had experienced various lingering effects from the accident. The DPC facility packages bulk dry liquid chlorine from tank cars into containers for industrial and municipal use in the St. Louis area. Spilled liquid chlorine vaporizes readily to form a toxic and corrosive gas.

The CSB report says that DPC installed an unsuitable hose connecting a chlorine rail tanker to equipment at its Festus facility. The hose braiding was made from stainless steel

instead of the recommended alloy, Hastelloy C, which looks identical but is resistant to chlorine. While investigators found that a supplier had furnished DPC with an improper hose, they said one cause of the accident was DPC's lack of effective management systems to prevent such a hose from being placed in service.

The Board called on both DPC and its hose supplier, Branham Corporation, to improve quality assurance programs, e.g. through the use of analyses to confirm that hoses are made from the correct materials. The Board also voted to recommend that chlorine and hose manufacturing companies develop an industry-wide system for positive identification of hoses. Another root cause cited by the Board was the lack of an effective testing and inspection program for the chlorine emergency shutdown system at DPC. Emergency shutdown valves failed to close properly once the chlorine leak had begun, greatly extending the duration and severity of the release. Investigators concluded that the valves were inoperable due to internal system corrosion, in turn caused by inadvertent introduction of moisture into the chlorine system. DPC's testing and inspection program was inadequate to uncover the faulty condition of the valves before the accident occurred and should be improved, the Board said.

The Board also recommended improvements to emergency response and community notification systems, while Board members praised the efforts of the mainly volunteer forces that responded to the accident. The report found a lack of adequate planning and training for a major release and noted that emergency breathing equipment stored at the plant became inaccessible once the leak had begun. Ultimately it took three hours for personnel in protective suits to reach the rail car and close manual valves cutting off the flow of chlorine, by which time more than half the contents of the tanker had been released. "Materials verification, emergency shutdown, emergency response: none of these systems worked well enough to protect workers and the public," according to CSB Chairman Carolyn Merritt. Merritt expressed sympathy for the community concerns raised at the meeting and said "local agencies need to be responsive." Merritt earlier authored a successful amendment to the report calling for a follow-up community meeting to be organized by state agencies.

The CSB is an independent federal agency established in 1998 with the mission to protect workers, the public, and the environment by investigating and preventing chemical accidents. The CSB determines the root causes of these accidents and makes safety recommendations to government agencies, companies, and other organizations. The CSB does not issue fines or citations or apportion responsibility for accidents.