



## **WHAT'S HAPPENING?**

**March 2013**

**Welcome to  
our new  
Associate  
Members**

**Mel  
Manderson  
Queensland**

**Daniel Martin  
Queensland**

**Ron Thirkill  
Queensland**

### **DR AS/NZS 1596**

### **DRAFT Australian/New Zealand Standard The storage and handling of LP Gas (Revision of AS/NZS 1596:2008) (To be AS/NZS 1596:20XX)**

**CLOSING DATE FOR COMMENT: 5 April 2013**

**This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-015, Storage and Handling—Liquefied Petroleum Gases, to supersede AS/NZS 1596:2008, The storage and handling of LP Gas.**

**This edition is the result of a comprehensive review of the 2008 edition, in order to update procedures in light of industry best practice, and correct and update references.**

**A new informative Appendix, 'Impact protection', for assessing the requirements for the protection of tanks and cylinders from impact, has been introduced.**

**A new informative Appendix, 'Transport of portable LP Gas cylinders for trade use covering the transport of cylinders for trade use, has been included. This has drawn heavily on safety notes and bulletins produced by various government bodies following an increase in safety incidents in this area**

**Addressing additional safety concerns regarding the hazardous nature of working in underground pits, a number of changes have been made in this area.**

**Appendix K has been reviewed to bring the emergency planning aspects of the code in line with current emergency services terminology and practice.**

**A significant number of minor changes have been made to align the Standard with New Zealand regulatory practice and it is envisaged that the Standard may be called up in legislation in New Zealand in the future. This Standard has been revised in terms of safety and technical matters.**

**Source: SAI Global**



Photos: Michael Jarvin



The fire at the Chevron refinery in Richmond on has brought close scrutiny by Cal/OSHA. Photo: D. Ross Cameron, Associated Press

## **AIDGC Hazardous Areas Workshop**

**This Workshop was initially proposed at the last AIDGC Conference where 35 attendees indicated that they were interested. It was held in February this year at the offices of SKM at St.Leonards and conducted by Dennis Oxmam from Wollongong TAFE.**

**19 people attended, AIDGC Members, WorkCover and industry personnel. All the reports were positive, all felt that the commitment to the course was worthwhile.**

**Each will receive TAFE qualifications for dust and flammable vapours once they have submitted a Case Study to the Trainer on the Hazardous Areas Class of Vapours.**

**The AIDGC is considering whether to also accredit successful participants with two AIDGC competencies.**

## **U.S.A. – Regulators and Safety - Chevron Refinery Safety under Microscope**

**California's OSHA workplace-safety agency has spent the equivalent of one-fifth of its entire annual budget investigating last year's Chevron Richmond refinery fire, a top state official testified during a hearing at which a lawmaker suggested the state needed to strengthen its regulatory efforts.**

**Under questioning in Sacramento by Senator Loni Hancock, D-Berkeley, state Department Of Industrial Relations head Christine Baker said Cal/OSHA has dedicated more than 4,000 hours to determining whether Chevron violated safety regulations in connection with the August fire. Cal/OSHA has slapped Chevron with 25 citations, most of them serious, for allegedly violating safety rules and is seeking nearly \$1 million in penalties. Chevron is appealing the fines.**

**Hancock, whose district includes the Richmond refinery, said the resources that the state is pouring into the Chevron probe suggest that Cal/OSHA is shorthanded. The agency's staffing is one area being looked at by a task force that Governor Jerry Brown created after the Richmond fire to evaluate refinery safety in California. Baker, whose department oversees**

**Cal/OSHA and who is a member of the task force, said, "We have identified gaps" in the state's regulatory efforts. Cal/OSHA has 164 inspectors, only seven of whom are assigned to refineries and chemical plants. That amounts to one inspector per 115,000 workers.**

### **After-the-fact probes**

**California regulators have focused on responding to accidents and worker complaints at the state's 15 refineries rather than conducting planned inspections. The Chronicle has reported that in the past decade, those planned inspections consisted of an average of 50 staff hours of checks and resulted in no fines being collected from major oil companies. Of the three planned inspections of Chevron before the August fire, one**

did not involve an actual visit to the plant.

In contrast, a national inspection effort that began after a Texas refinery explosion killed 15 workers in 2005 entailed about 1,000 staff hours apiece and resulted in an average of 11 citations against violators. Hancock pointed out that Chevron engineers had determined years ago that the Richmond refinery's lines were at risk of corrosion from sulfur-heavy oil, but that refinery managers had decided not to replace some of them. One such corroded line finally sprang a leak on August 6, starting the fire. No workers were seriously injured in the blaze, but 15,000 residents went to hospitals complaining of respiratory and other problems caused by a cloud of toxic gas and smoke. Baker said her agency is considering ways to get refineries to share more information about their operations with regulators.

Source: Jaxon Van Derbeken, San Francisco Chronicle

## **Report on Chevron 2012 Pipe Rupture and Fire; Extensive Sulfidation Corrosion Noted**

<http://www.csb.gov/newsroom/detail.aspx?nid=457>

## **Metallurgical Examination of the Samples from the Chevron, Richmond Refinery**

[http://www.csb.gov/assets/document/CSB\\_Final\\_Report\\_5004\\_7920.pdf](http://www.csb.gov/assets/document/CSB_Final_Report_5004_7920.pdf)

## **South Korean Chemical Plant Blast Kills 7**

A massive explosion at a chemical plant on March 14 in Yeosu, South Jeolla Province, left seven workers dead and 13 injured. The explosion took place at a high-density polyethylene plant in the city's industrial complex owned by Daelim Industrial.

A similar explosion killed one person at the complex in 2003. Police believed that lingering gas in a storage tank reacted with a flammable substance and exploded. A fire broke out after the explosion but was contained in 10 minutes. Welding work was being done when the tank exploded, fire-fighters said. "Rather than the fire, it was the shock from the massive explosion that caused the high death toll," police said. Many of the injured were severely burned so the number of deaths is likely to rise.

Source: ChosunMedia, CHOSUNILBO



**Batteries caught fire in aircraft baggage container during flight**



**Laptop fire in overhead baggage bin on passenger aircraft**



**A Japan Airlines Boeing 787 Dreamliner jet aircraft is surrounded by emergency vehicles while parked at a terminal (Stephan Savoia/AP Photo)**

**787 BATTERY  
'SMOKING , HISSING'  
The US National Transportation Safety Board has released 547 pages of reports and supporting materials about its investigation of the January airplane battery fire in Boston that led to the grounding of the Boeing 787.**

**Source: AAP**

## **Lithium Batteries – What? Again?**

**IATA issued a second addendum (see the link above). More airlines have jumped on board by adding restrictions relating to Lithium Batteries.**

**As of March 1st the Boeing B-787 Dreamliners are still grounded by the FAA and Boeing.**

**That ought to give you some idea of the potential dangers involved with these batteries.**

**If you still don't take the risks seriously, the next time you take a flight somewhere bear in mind that the aircraft is likely to be transporting lithium batteries as cargo and you or other passengers probably have lithium batteries in your pocket, purse, cell phone, laptop or tablet.**

**Have a safe trip.**

**Source: <http://www.r-a-specialists.com/news/2013/1303.shtml>**



## **NTSB Prepares to Disassemble JAL 787 APU Battery**

**Boeing's grounded fleet of 787 Dreamliners will resume flying within weeks, company executives said today, after Boeing engineers developed layers of additional safety measures to eliminate the risk of fire from a faulty lithium ion battery system.**

**Speaking to reporters in Tokyo, Chief Engineer Michael Sinnett fiercely defended the Dreamliner, calling it "among the safest airplanes" in Boeing's history. He said engineers had spent 200,000 hours analyzing what caused batteries on two of its flights to overheat in January. In one incident, a lithium ion battery caught fire on a Japan Airlines flight parked at Boston's Logan Airport. Smoke from a battery system on an All Nippon Airways flight in Japan forced an emergency landing and prompted U.S. and Japanese regulators to ground all 50 Dreamliners indefinitely.**

**"We may never get to the single root cause [of the problems]," Sinnett said. "But the process we've applied to understand what improvements can be made is the most robust process we've ever followed in improving a part in history."**

**In Boeing's first detailed explanation of the proposed changes to the battery system, Sinnett said engineers had identified 80 potential problems that could lead to a battery fire and redesigned the system to eliminate any fire risk. Boeing plans to add a battery enclosure made of stainless steel, preventing any gas released from the batteries from spreading to the rest of the plane. Engineers also plan to add heat-resistant sleeving, and extra insulation spacers.**

**Sinnett said he was "confident" a fire would not occur, but that he could not rule out battery failures in the future. Source: [abcnews.go.com](http://abcnews.go.com)**

## Seven Dead in N.E. China Acid Leak

Seven people have been confirmed dead after 2,000 cubic meters of sulphuric acid leaked in northeast China's Liaoning Province on Friday afternoon, local authorities said on Sunday. Rescue efforts ended Sunday at the scene in Fangshen Village, Jianping County, where a sulphuric acid tank suddenly broke and leaked at 3 p.m. on Friday. Local environmental protection authorities said monitoring showed the water quality and air near the site were normal. Workers are still transferring the remains of the leaked material and treating the polluted land. The private factory which owned the tank was illegal, said the official. The cause of the tank breach remains unclear.

Source: Liu Ranran, <http://english.cri.cn/6909/2013/03/03/2821s751505.htm>

## NICNAS Chemical Gazette

The latest issue, March 2013, is now available at:

[http://www.nicnas.gov.au/Publications/Chemical Gazette/Chemical Gazette March 2013.asp](http://www.nicnas.gov.au/Publications/Chemical%20Gazette/Chemical%20Gazette%20March%202013.asp)

## Ammonia Leak at Orica –Kooragang Is.

Orica and the Environmental Protection Agency are investigating an ammonia leak that occurred at Orica's Kooragang Island ammonia plant on March 14.

AAP reports that a "plume of ammonia belched into the air from the vent stack of an Orica factory" at the site, which manufactures ammonium nitrate for mining as well as fertiliser products.

"Detectable levels of ammonia were reported at industrial sites to the west of the Orica facility," said Orica in a statement, which also put the leak down to the lifting of a relief valve, which has since been reset.

"The relevant authorities were notified, including the NSW Environment Protection Authority (EPA) and NSW Fire and Rescue."

*The Newcastle Herald* reported yesterday that outdoor staff were instructed to go indoors, with emergency worker staff summoned but not required.

Source: Australian Mining

## IATA Addendum – Important

On February 14th IATA issued an addendum to the 54th Edition of the IATA DGR which became retroactively effective 1 January 2013.

You can download a copy by clicking here:

<http://www.r-a-specialists.com/pdf/IATA%20DGR54%20Addendum2-Feb13.pdf>

The addendum drops Special Provision A51 from column M of the Dangerous Goods List.



Photo: Fairfax Media

## **Another Mine Accident in China Kills 21**

**A gas blast at a coal mine in China's southwest has killed 21 people, with a further four missing. According to The Australian, Chinese state media reported that after the coal and gas outburst at the Machang coal mine, 58 workers had managed to get to the surface safely.**

**The official Xinhua News Agency reported that the workers at the coal mine in Zhangjiakou city died from carbon monoxide poisoning when an air compressor caught fire underground.**

**The incident adds to China's poor mining safety record; last year alone 1,384 people were killed in coal mine accidents. Although some improvements have been made to the country's safety regulations in recent years, they are often ignored and serious accidents remain common place in China's mining industry. Earlier this year, a fire at a coal mine killed 11 miners, while in November last year, eighteen workers perished after an underground explosion.**

**China is the world's biggest coal consumer, using 3.8 billion tons of coal in 2011.**

**Source: Australian Mining**

## **W.A. – West Swan Shed Explosion**

**A backyard shed has caught on fire after an explosion at a West Swan property - believed to have been caused by someone using a heat gun near a gas cylinder.**

**Around 20 firefighters were called to the Victoria Road property just before 3pm, after a neighbour reported the explosion.**

**The Department of Fire and Emergency Services said that it took about 30 minutes to put out the fire.**

**A 40-year-old male and a 31-year-old female were taken to Royal Perth Hospital by St John Ambulance for treatment for burns.**

**Organised Crime Squad are attending the site.**

**Police said they will remain on site to monitor the situation and conduct traffic management. Source: West Australia Today**

## **Queensland: Gas Bottle Explosion**

**One man is dead and another is in a critical condition after a gas explosion in a unit complex at Beenleigh south of Brisbane.**

**Police say the gas bottle exploded inside a unit in George Street, critically injuring a 47-year old man and Police Inspector Geoff Palmer says a man in a separate part of the complex was overcome by the powerful blast, suffered a heart attack and died. He says the man who lived in the unit suffered terrible injuries to most of his body.**

**Two women in a neighbouring unit suffered minor injuries.**

**The blast destroyed the unit, levelled external fencing and cut the building's electricity supply. "All the windows have been blown out as well as the door," Inspector Palmer said. "There is also damage to property outside the unit in the courtyard outside the unit block."**

**Inspector Palmer says it appears the bottle was ignited deliberately.**

**Source: ABCNews**



Image: news.xin.msn.com



A man is admitted to Royal Perth Hospital – photo. ABCNews



Photo: ABCNews



Elaine Kelly and her sons were among those rescued from the roof. Photo: Janie Barrett

## **Basement Car Fire – Pyrmont, N.S.W.**

Nineteen people, including four children, were rescued from the roof of a Pyrmont apartment building after a fire broke out in the basement car park. Firefighters used a cherry picker to reach the residents who had gone up to the roof to escape clouds of thick smoke that had engulfed the building. NSW Fire and Rescue Superintendent Rick Parkes said the fire started in a car in a basement garage.

Ms. Kelly, who was evacuated with her children, said she smelt something burning and thought it was in her apartment. But when she went to the window and opened the blinds she saw smoke billowing from below. When she opened the front door of her top-floor apartment, she saw black smoke everywhere. "All the alarms were going off. It was so black I could hear my neighbours talking but I couldn't see them."

Emergency services told residents to gather in one apartment but when the smoke became too thick they went up to the roof. Superintendent Parkes said the fire stairs led to the basement so, for the 19 people who became trapped, the only way out was up.

The thick smoke could have been toxic, he said. "[A burning car] generates smoke such as hydrogen phosphine, which they use in chemical warfare, and it also generates carbon monoxide and carbon dioxide."

Source: Natalie O'Brien, Sydney Morning Herald

## **Interested in Keeping up with the BP Deepwater Horizon Trial?**

Court documents are being posted at this link:

<http://www.mdl2179trialdocs.com/>

## **BP Ordered to Assess Damage from Toxic Chemical Spill - Queensland**

Oil giant BP has been ordered to prepare a report on what damage was caused when a toxic chemical spilled into a far north Queensland waterway.

The Department of Environment and Heritage Protection (EHP) launched an inquiry after 30,000 litres of water containing fluorinated firefighting foam was discharged into a Cairns inlet in January. The spill, which came from a nearby depot, was caused by a malfunction of fire suppression equipment, a BP spokesman says.

He says there has been no environmental impacts as a result of the spill but BP will co-operate with authorities to further assess any damage. BP has until May 31 to prepare the report.

The environment department has the power to issue warnings, fines, or prosecute anyone who breaches the Environmental Protection Act.

Source: AAP



## **DMP in W.A. Clamps down on Unsafe Drivers**

The Department of Mines and Petroleum (DMP) has continued its crackdown on drivers who transport dangerous goods in an unsafe manner.

In a recent roadblock, DMP Dangerous Goods Officers – along with WA Police – stopped around 566 vehicles on Great Eastern Highway in Northam.

Twenty seven charges relating to dangerous goods have now been laid, with three involving major non compliance – including non-existent safety equipment such as fire extinguishers and emergency eye wash, incorrect or lack of placarding, and no transport documents.

The roadblock also saw one driver charged with drink driving offences, in addition to dangerous goods placarding issues.

“Each agency operating on its own may not have identified both offences,” said DMP Principal Dangerous Goods Officer Peter Xanthis.

“It was very disappointing to see a driver allegedly break the law twice – putting the community at risk.”

He urged drivers who transport dangerous goods such as fireworks and chemicals to abide by the law.

“When it comes down to it, drivers need to remember the ‘three Ps’ - placarding, paperwork and personal protective and safety equipment (PPE),” said Mr. Xanthis, who noted the latest roadblock was indicative of the close working relationship between WA Police and DMP.

“There is a collaborative relationship between the department and Wheatbelt Traffic Police – and this shines through in our work.”

The dangerous goods roadblocks are part of the department’s annual partnership with WA Police and Main Roads – to tackle unsafe transportation of dangerous goods.

DMP is set to join other government agencies to carry out Operation AUStrans in the near future.

Source: <http://www.dmp.wa.gov.au>

## **Orica to Clean up DDT-Contaminated Site**

Chemical company Orica will remediate about 25,000 cubic metres of DDT-contaminated soil at an industrial site in western Sydney.

The soil, at Christina Road in Villawood's industrial precinct, was contaminated from waste by-products during industrial activities between 1941 and 2000, Orica said in a statement.

The site was originally part of a World War Two weapons factory and later used by Orica — then known as ICI — to manufacture crop chemicals, including the now-banned insecticide DDT.

Remediation will take about 15 months and will be undertaken by a contractor. DDT was manufactured at the site until 1961.

Orica says the site is no longer operational.

Source: Industry News

**Diarize  
these  
Dates!**

**April 30  
Roger Klein  
AIDGC  
Seminar**

**HAZMAT  
2013  
May 1 and 2  
Technology  
Park  
Sydney**

**July 26  
AIDGC/AGM  
with keynote  
Speaker**

**September 20  
AIDGC  
Annual  
Conference**

## **Firm & Consultant Fined - Chemical Exposure**

A Cambridge, U.K., instrument company and a health and safety consultant have been fined for risking the health of employees from hazardous chemicals.

Paint sprayer Adam Coventon, 36, suffered irritation to his eyes, breathing difficulties and headaches, and lost the ability to concentrate after working with harmful substances at Prior Scientific Instruments Ltd in Fulbourn. He is now no longer able to work.

An HSE investigation found that Prior Scientific Instruments did not provide suitable equipment to adequately remove the hazardous fumes from the workplace, especially where items were left to dry.

The company also failed to provide employees with the necessary health surveillance for workers using hazardous substances.

Cambridge Magistrates' Court was told that between September 2002 and December 2009 the company employed Keith Whiting, trading as KW Consultants, as a health and safety consultant.

However, he did not provide suitable information and advice to enable the company to ensure the health and wellbeing of employees.

Prior Scientific Instruments Ltd, of Wilbraham Road, Fulbourn, Cambridge, was fined £9000 and ordered to pay full costs of £2852 after pleading guilty to breaching section 2(1) of the Health and Safety at Work etc Act 1974.

Keith Whiting, trading as KW Consultants, of West Street, Chatteris, Cambridgeshire, was fined £1500 with costs of £1000 after pleading guilty to breaching section 3(2) of the same legislation.

After the hearing HSE inspector Robert Meardon said: 'Prior Scientific Instruments failed to ensure the health of its employees because it employed the wrong person to give it health and safety advice.

'Mr. Whiting's background was in quality control and he did not have adequate knowledge of health and safety for the work going on in this company. He failed to make them aware of the 'dos and don'ts', regarding the use of hazardous chemicals.

'In 2010, the Government commissioned a review of health and safety laws and, among the findings, the inquiry recognised that there were a lot of people claiming to be health and safety experts, who were in fact not.

'The national register of health and safety consultants has been set up as a result. All the consultants who are registered are members of a recognised professional body, and it is important that firms seeking to use a consultant choose one from the register.'

Adam Coventon's partner, who does not want to be named, said: 'This whole thing has had a huge effect on our lives, as we have to constantly plan around Adam's symptoms. We all just wish that his remaining symptoms go so that he can once again be fit and strong.

'This case highlights the important job the Health and Safety Executive do, and the need for companies to monitor and control chemicals they use so they do not wreck people's lives in the way that ours has been.'

Source: [www.hse.gov.uk/cosh](http://www.hse.gov.uk/cosh)



Photos: ABC Chopper 7



YouTube Clip of the explosion:

[http://www.youtube.com/watch?feature=player\\_embedded&v=uZSi\\_wVXd78](http://www.youtube.com/watch?feature=player_embedded&v=uZSi_wVXd78)

## Paint Plant Explosions Injure Three

Two explosions and a massive fire at a coatings plant near Chicago this week injured three people and sparked panic in the surrounding area. The first explosion shook Fox Valley Systems Inc., followed several minutes later by a large fire. The company, located in an industrial park in Cary, IL, manufactures traffic, athletic, and marking paint and striping equipment. Cary is about 45 northwest of Chicago.

As firefighters worked to extinguish the blaze, a second explosion about 2:45 p.m. intensified the situation. After the second blast, firefighters were pulled away from the building and "went into a defensive position" to prevent the fire from spreading. Three workers were taken to a local hospital, but the extent of their injuries has not been reported.

The explosions blew out both the front and back walls of the building as flames and heavy smoke poured out, several local media outlets reported. Between 25 and 35 nearby buildings were evacuated as a precaution. Firefighters from 15 departments battled the fire for several hours, and a hazardous materials foam truck was brought in to help tame the flames. The chemical nature of the fire was not immediately known, Cary Police Chief Steve Casstevens told CBS Chicago.

Officials have not determined what led to the explosions.

Fox Valley Systems has received several OSHA citations in the past. Most recently, in 2009, the company was cited with two serious violations involving heavy machinery. In 2004, OSHA also issued two serious violations, citing standards for "general requirements" and "hazardous (classified) locations." Source: PAINTSQUARE

## IATA 2013 54th Edition DGR Changes

Significant changes to the 2013 IATA Dangerous Goods Regulations – Goto: <http://www.dgtraining.com/Home/DGR54-Significant-Changes.pdf>

## List of "Hidden Dangerous Goods"

[http://www.dgtraining.com/Resources/HiddenDGs\\_2013.pdf](http://www.dgtraining.com/Resources/HiddenDGs_2013.pdf)

## Chemical Plant Explosion in SW China

Photos taken on February 25, 2013 shows the scene of a chemical plant blast in Baiyun district of Guiyang, capital of Southwest China's Guizhou Province. At least five people were injured in a chemical plant explosion in Guiyang on Monday morning. Part of the plant, which belongs to Bestchem, a local chemical company, was still burning by noon. Firefighters have been deployed to the blast scene while local environmental authorities are keeping an eye on the air quality. (Xinhua/Liu Xu)



## **Workers Flee Scotch Whisky Fire**

**A major scotch whisky manufacturer has been fined after two workers had to flee a warehouse fire. Glasgow Sheriff Court was told at an earlier hearing that two workers were filling casks in a warehouse in The Edrington Group Limited's premises. The men were on a metal walkway at the top levels of the warehouse using flexible hoses to fill the 450-litre casks with whisky which was being pumped from steel vats. After filling four of them, one worker felt the hose he was using relax then heard a whoosh of liquid towards the forklift truck. He turned to see a jet of whisky shooting up towards a ceiling light fitting above the truck. The whisky hit the light fitting and a flame engulfed the cage of the forklift truck.**

**Around the same time his colleague heard a 'pop' from the cage and then saw a flame spread across the roof from the light fitting both towards and away from them. Both workers ran towards the stairs at the back of the warehouse, activating the fire alarm as they left, prompting the evacuation of the whole site within several minutes.**

**The court heard that thousands of litres of the burning spirit poured down the racked casks and onto the forklift truck until the supplying pump was turned off about 15 minutes later.**

**It was later discovered that 70 of the 110 sprinkler heads in the warehouse had been activated.**

**An investigation into the incident by the Health and Safety Executive (HSE) found that the central aisle lights in the warehouse should not have been used in a flammable atmosphere and, had they been checked, they would have been identified as an ignition source risk. HSE's investigation also revealed that the filling equipment was not suitable for use to transfer a hazardous substance like alcohol at pressure.**

**The Edrington Group Limited, Great Western Road, Glasgow, was today (27 February) fined £40,000 after pleading guilty to breaching Section 2 of the Health and Safety at Work etc Act 1974.**

**After sentencing, HSE Inspector David Stephen said: "This was a major incident that could have had disastrous consequences. The two workers had to run for their lives and were extremely lucky not to have been killed or seriously injured.**

**"More than 17,500 litres of whisky were lost during the incident. This volume of flammable liquid could have served as fuel for a significant fire, which would have caused major disruption and damage to the environment.**

**"Had the company taken the simple steps of checking the light fittings were suitable for use in a flammable atmosphere and that the equipment used to transfer the alcohol was fit for purpose this incident could have been prevented.**

**"Since the incident, the filling of whisky casks in this way at the premises has been made redundant with the introduction of a new tank facility in October 2011."**

**Source: <http://www.hse.gov.uk>**



Burned forklift the victim was operating.

## **Flash Fire Fatality – Overhead Pipe Rupture**

A 61-year-old powered-industrial truck operator died after his forklift ruptured a pipe containing a solvent mixture and the vapours ignited. The victim was operating his forklift in an area between a stacker and a printing press in order to pick up a waste pallet and transport it to the recycling area. Some part of the forklift struck an overhanging pipe containing toluene and ethyl benzene dislodging a ball-valve assembly and dousing the victim and forklift with the solvent mixture. The victim drove the forklift forward and then back under the flowing solvent, then drove the lift to the stairs below a bank of meters and ball valves. He dismantled the lift and walked up the stairs and closed the correct ball valve to stop the solvent stream. He went back down the stairs to the forklift. At this point a co-worker asked him how he was and he replied “I’m burning.” While the co-worker went to stop the printing press and obtain solvent-collection devices to contain the spill, the victim drove the forklift to the locker rooms where showers were located. The forklift was found in the hallway near the locker rooms where the solvent vapours had ignited and burned the victim and the lift. Emergency responders and the local fire department were called. The victim died in the ambulance on the way to the hospital.

Source: Safeteng

## **Worker Burned in Plant Fire Sues Company**

An electrician who was burned in an Indiana, U.S., chemical plant fire last week has filed a lawsuit that offers more details about the incident that sent him to the hospital and black plumes of smoke billowing from the facility.

Contract employee Toyo Gonzalez is suing Akzo Nobel Polymer Chemicals and plant manager Scott Fosom. According to the filing Gonzalez “suffered severe chemical burns to his face as a result of the defendant’s negligence.”

The March 4 incident happened as Gonzalez, an electrician for Jacobs Engineering, was working on an Akzo Nobel actuator that “was corroded and in disrepair,” according to the lawsuit. At some point, “the actuator broke and ejected a chemical” into his face, the filing states.

Gonzalez was assisted to a safety shower by a co-worker, then rushed to an on-site clinic where medical personnel tried to wash the chemical off his face. He eventually was transported to a local hospital and treated for facial burns.

Shortly after the incident, a company spokeswoman said the blaze was caused by magnesium oxide that exploded then caught fire. Two weeks after that incident, Hugo Ortega and Jose Gonzalez filed a negligence lawsuit alleging that they suffered “severe burns” when aluminum powder caught fire in a “tragic and wholly unnecessary disaster.”

According to the company’s web site, Akzo Nobel is the largest global paints and coatings company and a major producer of specialty chemicals.

Source: Cindy George, Houston Chronicle



An explosion blew off a corner of the one-story brick building's roof and wall, sending bricks and debris onto Burlington Northern railroad tracks.

## **Four Workers Injured in Plant Explosion**

Investigations began quickly Tuesday in the wake of a powerful blast that tore through the aging brick walls and roof of a chemical pressure-bottling plant and injured four workers, three seriously.

A corner of the Enviro-Safe Refrigerants plant in Pekin, Illinois, U.S.A., blew off in the explosion that reportedly took place near an assembly line and may have stemmed from a gas line malfunction.

While identities of the injured remained unavailable Tuesday night, two of the three listed in serious condition are a 57-year-old woman and a 50-year-old man - the third, a 52-year-old man, remained at OSF Saint Francis Medical Center in Peoria, with a 45-year-old woman listed in fair condition, a hospital spokeswoman said. All suffered burns "on various parts of their bodies," the spokeswoman said.

Other workers at the plant evacuated quickly from its rear doors, coughing and wheezing, said nearby resident John Gordon.

"It's surprising we don't have more people hurt than we do," police Public Information Officer Don Jolly said at the scene. "There's a lot of damage to the building."

Fire trucks and ambulances raced to the site in one of the city's oldest areas just north of downtown. Jolly said police, concerned about a serious chemical or gaseous leak, initially considered evacuating nearby homes. After an initial smoky cloud and dust from the explosion cleared, however, those concerns dissipated, he said.

The explosion reportedly came in an assembly line area of the one-story building, a former distillery. Initial investigation at the scene included the possibility of a malfunctioning gas line that, fed by an unknown ignition source, produced the explosion.

Local entrepreneur Randy Price converted the "century-old" structure into a bottling facility for his company that produces environmentally safe refrigerants in several renovated buildings in the city.

"I'm not going to quit" and close Enviro-Safe, Price said. "I'm the type of guy who's going to rebuild."

The blast appeared confined, but powerfully, to the southeast corner of the V-shaped building. Bricks from that section's upper wall fell in piles to the ground along and between railroad tracks running next to the building. Shattered glass and frames from four windows flew more than 30 feet.

"It was a big kaboom," that Gordon, 66, said he heard from inside his house at 127 Caroline about 50 yards from the building.

"I always figured since they started (the bottling operation) that this might happen, after seeing all those tanks outside for the refrigerant," he said.

Source: [pjstar.com](http://pjstar.com), Michael Smothers

**The Autumn 2013 Issue of SSA Magazine**

is now available at: <http://ssa.org.au/magazine/index.htm>

## **Dust Causes Fire in Industrial Plant**

Firefighters spent hours extinguishing a first alarm fire within a large duct system in a manufacturing facility in Gonic, New Hampshire, U.S.A.

Police, firefighters and emergency personnel responded after dust inside the ductworks caused a fire at Spaulding Composites Inc.

"There were smoldering fires throughout the ducts," Sanborn said, adding firefighters used inspection doors to extinguish the hot spots in 300 feet of ducts.

Sanborn said the first alarm fire recalled firefighters from Rochester while calling in assistance from Dover and Durham, including a rapid intervention team as a precaution. All of the employees were able to safely evacuate from the building and none of the workers or firefighters sustained injuries from the fire, according to Sanborn. "There's still some areas which are still smoldering now," Sanborn said, adding it will take time to ensure the fire is out and doesn't rekindle in the ducts.

Spaulding Composites manufactures a variety of components for heavy equipment, air tools, cryogenics, bearing retainers and other specialty items. Source: New Hampshire Union Leader, John Quinn

## **Toxic Industrial Chemicals (TICs)**

### **Chemical Warfare Without Chemical Weapons**

Over the second half of the 20<sup>th</sup> Century, numerous chemical incidents have threatened civil populations and the environment in several parts of the world. Hazardous properties of industrial chemicals range from explosive or highly flammable to corrosive or poisonous. Their toxicity is much lower than that of chemical warfare agents. However, even simple common chemicals can be extremely hazardous when released into the environment in large amounts. Hazardous material incidents may be either the result of transportation-related accident or release, or generated from a fixed site by deliberate or accidental causes or natural disasters, including fire, flood, storm or earthquake. On the other hand, a number of military actions against chemical plants and installations clearly showed that "toxic warfare" or "chemical warfare without chemical weapons" is possible. For full article from SCIENTIFIC REVIEW:

<http://fabad.org/fabad.org/pdf/volum31/issue4/220-229.pdf>

## **Toxic Vapours Found in Google Offices**

After a carcinogen was found to be seeping up from contaminated soil into buildings, Google is working to protect employees from a mess left behind by the Valley's earliest tech companies. Over 1,000 Googlers moved into "the Quad" in June of 2012, an area once home to Fairchild and Intel, among others. Those companies used TCE (trichloroethylene) as a solvent in the manufacturing of the first silicon computer chips, leaving behind a massive plume of contaminated groundwater discovered in 1981 -- one that may take many more decades to clean up.

Source: Mountain View Voice



## **Adhesive Manufacturing Plant Fire**

All five fire companies put out a fire at a facility that contained large vats of flammable industrial solvents, authorities said. Clifton Adhesives manufactures special industrial adhesives and coatings.

John Gabriel, chief of Company 2, was first on the scene and found heavy smoke and flames coming from inside a mixing room that contained large vats filled with the flammable solvents.

Using foam, the first firefighters inside the building, with the aid of the fire suppression system, "aggressively" attacked the fire.

The township's fire inspection bureau is investigating the cause of the fire. The township Fire Prevention Bureau, building inspector, and the Passaic County Health Department were assisting with the investigation and to help clean up any hazardous waste.

Source: Daniel Hubbard, Wayne Patch

## **Industrial Chemical Plant Gutted**

An industrial chemical plant in the Cuncolim industrial estate, Margao, India, went up in flames in the early hours of Monday after barrels containing concentrated propionic acid stored inside the unit caught fire. The entire plant was gutted in the fire, though no casualties were reported.

Official sources said that the plant was functioning under the name of Rajeshwari Speciality Chemicals Pvt Ltd and owned by Anand Honor from Karwar.

The fire broke out at around 6.50am following which the fire and emergency services (F&ES), on being informed, rushed to the site and launched fire fighting operations. There were no casualties. Sources said that the few workers who were present inside rushed to safety once the fire broke out.

Source: The Times of India

## **Major Fire at Chemical Units: India**

Major fire broke out in two different chemical manufacturing units at Jhagadia and Ankleshwar industrial estates on Monday. No casualties have been reported, however, both plants have suffered heavy damage. The first fire was reported from Yashashwi Rasayan Pvt Ltd, located on plot No.765 in Jhagadia industrial estate. The fire broke out during production of 2:4 Xylidine, an organic intermediate.

A leak in a reactor resulted in the breaking of a bottom control valve, which caused an explosive fire in solvent lying nearby.

Within an hour the flames had spread across the entire plant causing heavy damage.

More than six fire-tenders from Ankleshwar and Jhagadia industries and Disaster Prevention and Management Centre (DPMC) Ankleshwar rushed to the spot. They could finally control the fire after three hours.

Source: The Times of India, Harish Joshi



## **Three Killed in Gas Leak in Chemical Unit**

**Three workers died after inhaling a poisonous gas at an agro chemical factory in Ankleshwar on Saturday. Sources said the three workers employed on contractual basis at Meghmani Agro Chemical company in GIDC area inhaled the acrylonitrile gas following a leakage.**

**Deceased have been identified as Sanjay Prajapati (22) of Patan, Ratanji Rajput (23) of Unjha and Ghanshyam Kalasia (25) of Amreli. Deputy director of industrial health and safety department V J Patel said, "We have ordered immediate closure of the unit. This is a very unfortunate incident where because of negligence three workers have lost their lives." Sources said the leakage took place in the early hours of the day. A chemical process involving acrylonitrile and carbon tetra chloride was being carried out. "This process needs a proper temperature control. The persons responsible failed to control the high temperature that led to a reaction and subsequent leakage of the gas from a gasket of a reactor. We are investigating whether the company had installed proper gasket. Preliminary findings indicate that automatic temperature control valve was not installed," sources said. A criminal complaint is likely to be lodged against the company authorities for negligence leading to death. The workers who inhaled the poisonous gas were shifted to a private hospital in Ankleshwar town. All three were declared dead in an hour after they inhaled the gas.**

**Source: Times of India, harish joshi**

## **Food Prepared with Toxic Ammonium Nitrate Kills 3 - India**

**Three workers died and four others got seriously ill after reportedly eating khichdi containing ammonium nitrate, which was mistakenly added in place of salt, at a factory in Chinhat police station area late on Thursday night.**

**Chinhat Senior Sub-Inspector Rakesh Dikshit said seven workers employed at Vikas Power Equipments Private Limited factory on Deva Road were on night duty. They were given some money by their supervising officer Saurabh Singh for food. Instead of buying food from outside, he said, the workers decided to themselves cook khichdi inside the factory. While cooking, they realised they did not have salt. They went inside the painting section where they had earlier seen a box of "salt", but they mistook a box of ammonium nitrate for salt and used it in cooking.**

**Dikshit said police have recovered the food samples and the box of ammonium nitrate for examination. Sub-Inspector Sunil Singh said soon after eating kichdi, they started vomiting. The supervisor rushed them to Ram Manohar Lohia Hospital where two were declared dead on arrival. The other five were referred to King George Medical University where Another worker died on the way. The rest of the four, are undergoing treatment at KGMU. Source: The Indian Express**



#### About Author

Mr. R. R. Nair has more than 40 year's exposure in Occupational Safety, Health & Fire Protection. He is author of 15 books & more than 60 articles in various topics on Safety, Health & Environment. He has carried out more than 45 safety audits in various industries and high rise buildings.



Fig. 1 - The devastated venue of the DAV School functions in Dabwali, Haryana - Photo by Shanker Chakravarty – (Courtesy: frontlineonnet.com)

## Fire and Explosion Hazards

### Industrial Safety Review pub. India

*India has witnessed several devastating fires, explosions and toxic releases which not only claimed the life of hundreds but also huge property loss. In spite of the existence of the National Building Code of India and several fire safety regulations enacted by various state governments and local bodies, the fires and explosions are mounting day by day throughout the country.*

#### 1. INTRODUCTION :

There are three types of hazards viz., fire, explosion and toxic release, occur in industry in particular chemical process industries. In many instances, more than one of these hazards occurs in tandem of each other.

Fires occur in industry, more frequently than explosions and toxic releases, although the consequences in terms of loss of life are generally less. However, if the ignition of escaping flammable material is delayed, an unconfined vapour cloud of flammable material may be formed, which if ignited, can cause violent explosion, resulting in extensive damage.

The fire is the first major hazard in the chemical / process industries and causes more serious accidents than explosions or toxic release, although the accidents in which the greatest loss of life and the damage occur are generally caused by explosion.

Fire is normally regarded as having a disaster potential less than explosion or toxic release. It may be remembered here that the world's worst industrial disaster – Bhopal Gas Tragedy - occurred on the night of 2 - 3 December 1984, due to toxic release of the chemical “methyl isocyanate” and over 5,00,000 people were exposed to this chemical. However, ‘toxic releases’ are not dealt in this article. The scope of this article is confined to Fire and Explosion hazards only.

#### 2. FIRES AND EXPLOSIONS IN INDIA :

Fire is a serious hazard in India and on an average about 25,000 people dies every year due to fires and explosions. India has witnessed several devastating fires and explosions that have claimed hundreds of innocent lives and property damages. Some of the major fires and explosions occurred in India are given below along with few images of the incidents (See Fig. 1 to 6).

##### Selected Major Fires and Explosions in India

**April 14, 1944 :** A major explosion occurred in the Victoria Dock of Bombay when the freighter SS Fort Stikine carrying mixed cargo of cotton bales, gold, and ammunition including around 1400 tons of explosives, caught fire and destroyed in two giant blasts, scattering debris over 2 square miles, sinking 27 other ships in Victoria Dock and neighboring Princes Dock and setting fire to the area killing around 800 people and injuring about 3000.

**November 9, 1988 :** A fire occurred on a light naphtha storage tank of BPCL Refinery at Mumbai. The tank was overfilled and consequentially over pressurized because of the faulty indication tank level gauge, which



Fig. 2- Flames inside the Brihadeeswara Temple complex.

Photo by K. Ganesan.  
(Courtesy: [frontlineonnet.com](http://frontlineonnet.com))



Fig. 3- The burnt-out parking lot of Uphaar Cinema, in New Delhi.

Photo by Rajeev Bhatt.  
(Courtesy: [frontlineonnet.com](http://frontlineonnet.com))



Fig. 4 -Inferno: Fire sweeping through the stalls of the trade fair in Meerut.

(Courtesy: [hindu.com](http://hindu.com))

was repaired a couple of days prior to the incident. The tank roof ruptured releasing a large amount of hydrocarbon vapour spread over an extended area and ignited. - 35 persons killed and 23 injured. Out of the 20 tanks located in the farm area, 5 were damaged.

**November 6, 1990 :** A leak occurred on a pipeline transporting ethane and propane to the gas cracker complex of IPCL petrochemical plant at Nagothane, Maharashtra. A vapour cloud formed and ignited at an off site gas treatment plant and compression facility. The cracker was not damaged by the resultant vapour cloud explosion, but serious damage was done to off site units - 31 persons killed.

**December 23, 1995 :** A fire broke out at the Rajiv Marriage Palace in Mandi Dabwali, Haryana, where the DAV School was holding its annual prize distribution function. A synthetic tent which had been setup inside the building caught alight, when an electric generator short-circuited. The fire spread quickly and blocked the main entrance. Many of the deaths were caused by the stampede as 1,500 people tried to escape through the single exit door. - 448 people including 230 children killed, and over 300 injured, (See Figure 1).

**June 7, 1997 :** A fire broke out in the yagasala of the Brihadeeswara Temple, Thanjavur. Inflammable materials likes' ghee, condiments and thatched roofs helped the fire spread fast. Most of the victims died after inhaling carbon monoxide; while a few were killed in a stampede. - 40 killed, 85 injured, (See Figure 2).

**June 13, 1997 :** A fire engulfed the Uphaar Cinema at Delhi due to a blast in a transformer in an underground parking area in a five story building, which housed the Cinema hall. Most of the victims were trapped in the balcony and suffocated to death when poisonous smoke engulfed the hall - 59 killed and over 100 injuring in the subsequent stampede, (See Figure 3).

**September 15, 1997 :** A large LPG leak occurred at the manifolds area below a sphere containing about 1000 tones of LPG, at HPCL Refinery at Vishakhapatnam. The resulting vapour cloud spread to an area of about 250 m radius and exploded on ignition - 57 people were killed. The explosion damaged 4 other spheres a number of liquid petroleum storage tanks and several buildings.

**April 10, 2000 :** A devastating fire broke out at a tent of 'Brand India Fair' at Victoria Park, Meerut. The cause of the fire was due to an electrical short circuit within the structure. The fire also led to the explosion of gas cylinders at the makeshift kitchen at the site which soon engulfed the area turning the park into an inferno. At least 100 people were killed, (See Figure 4).

**January 23, 2004 :** A major blaze engulfed Padmapriya Marriage Hall at Srirangam, near Tiruchi, in Tamil Nadu. The probable cause of the fire was due to a short circuit which resulted from a wire of videographer's camera - 62 people including the bridegroom were killed and 45 severely injured.

**July 16, 2004 :** A major blaze raged through the Sri Krishna / Saraswati English M Kumbakonam when its thatched roof caught fire - About 93 children aged 6 and 10 were charred to death.



Fig. 5 - A massive fire at the Indian Oil Corporation's (IOC) depot near Jaipur. (Courtesy: ibnlive.in.com)



Fig. 6 - One of the working sheds in fire at the Om Sakthi Fireworks Industries in Muthalipatti near Sivakashi – Photo by R. Ashok (Courtesy: thehindu.com)



Fig. 7. - Example of Jet Fire -A large fire destroyed the Piper Alpha oil platform in the North Sea. (Courtesy: exponent.com)

**October 29, 2009 :** A fire broke out at the Indian Oil Corporation's oil depots giant tank holding 8000 kilolitres of oil, in Slopura Industrial Area on the outskirts' of Jaipur, Rajasthan. The blaze continued to rage out of control over a week and during the period half a million people were evacuated from the area. The Meteorology department recorded a tremor measuring 2.3 in the Richer scale when the first explosion occurred which resulted in shattering of glass windows nearly 3 kilometers from the accident site – 12 killed and injuring over 200, (See Figure 5).

**December 9, 2011 :** A blaze started in the basement of building of AMRI Hospital, Dhakuria, Kolkata and quickly spread, trapping hundreds of people – 94 patients and staffers were killed.

**July 30, 2012 :** A coach of Delhi – Chennai Tamil Nadu Express caught fire near Nellore in Andhra Pradesh at the wee hours – 35 passengers were killed and 25 injured.

**September 5, 2012 :** A powerful explosion tore through one of the biggest fire works factories, Om Sakthi Fireworks Industries Crackers in Sivakashi, Tamil Nadu, triggering a major fire. The blast reduced 40 to 48 sheds in the fireworks unit to rubbles in no time. - About 50 people killed and more than 75 injured, (See Figure 6).

*Fires can take several different forms, such as jet fires (flames), pool fires, running liquid fires, flash fires, fireballs, vapour cloud explosions and boiling liquid expanding vapour explosions (BLEVEs), which are outlined below:*

### **3. JET FIRES :**

There is a wide variety of situation in which a jet fire or ejected flame, can occur, either by design or accident. The principal situations in which flames occur by design are burners and flares. Ejection of flammable liquid from a vessel, pipe or pipe flange, can give rise to a jet flame if the material ignites. Jet fires dissipate thermal radiation away from the flame's visible boundaries. The energy transmitted could be hazardous to both life and property.

Scenarios involving jet flames are not easy to handle, since a large jet flame may have substantial 'reach' sometimes up to 50 meters or more. A jet fire would appear as a long narrow flame through a small aperture / hole / orifice. In other cases jet flames from pressure relief valves have cost adjacent vessels to overheat and burst a boiling liquid expanding vapour explosion (BLEVE).

Jet fires or flames have been involved in a number of accidents.

**Perhaps the most dramatic were the large jet flames from the gas riser on the Piper Alpha Oil Platform in the North Sea (See Fig. 7).**

On the night of 8th July 1988, a series of violent explosions and a large fire destroyed the oil platform. Only 62 crew members survived out of the 229 persons on board. Many workers were trapped because rescue helicopters could not approach when confronted with flames 100 meters high. The majority of those who survived jumped from the platform into the rough sea.



Fig. 8. - Example of Pool Fire  
(Courtesy: arshadahmad.wordpress.com)

#### **4. POOL FIRE :**

A pool fire occurs when a flammable liquid spills onto the ground and is ignited. A fire in a liquid storage tank is also a form of pool fire, as in trench fire. A pool fire may also occur on the surface of flammable liquid spilled onto water.

A pool fire is defined as “a pool of flammable liquid burning with a stationary diffusion flame or the combustion of material evaporating from a layer of liquid at the base of fire”.

A pool fire is a complicated phenomenon. A pool fire burns with a flame, which is often taken to be a cylinder with a height, twice the pool diameter. In still air, the flame is vertical, but in wind it tilts. Wind also causes the base of the flame to extend beyond the downwind edge of the pool, thus exhibiting flame drag. With some pool fires blowout can occur at wind speed of about 5m per second.

The characteristics of pool fire depend on the pool diameter. The liquid burning rates increases with the diameter until for large diameters it reaches a fixed value. The heat radiated from the flame behaves similarly. A pool fire can take place in a storage tank, as for example, in a tank, which has lost its top, as a result of either internal or external explosion (See Fig. 8). The fire may also take places in a bund. In both the above cases, the boundary of the pool is clearly defined and the shape of the pool may be circular or rectangular. Other types of pool fire occur after a liquid is discharged on the ground, the shape and depth of the pool being determined by the local contours.

Pool fires, especially in bunds, which are either circular or square, have an approximately cylindrical shape. In the absence of wind, this would be an upright cylinder. But usually wind is present and the cylinder is oblique / tilted / inclined. A notable feature of pool fire is that of down-wind ‘spill over’ or ‘flame drag’. This spill –over increases the effective diameter of the pool fire by 50% of the bund diameter.

The pool fires have occurred at many places and the one occurred at Cleveland, Ohio, USA, in 1944 is important to remember. In this fire about 3,000 T of LNG ‘spilled over’ from several storage tanks and caused large scale pool fires. The accident resulted in 128 deaths and 400 injuries.

#### **5. RUNNING LIQUID FIRES :**

A running liquid fire involves the spread of flame across the surface of a flammable liquid spillage. In spread and extent, the fire is greatly influenced by local topography. As the spread is often promoted by, drains and trenches, it is necessary to consider the radiative effects from fires spread in this way.

Thin flames are less radiative than thick flames. Hence, drains can be built with narrow necks, opening into larger volumes below the surface. The design shall allow for presence of firewater and for separating immiscible liquids when desired.

#### **6. FLASH FIRE :**

Flash fire is also known a vapour cloud fire. Flash fire is defined as “the combustion of a flammable vapour and air mixture in which flame passes through the mixture, at less than sonic velocity (speed of sound in the medium), such that negligible over pressure is generated”. A flash fire,

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newspaper pars, or  
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could contribute to  
entertaining and  
informing our  
Members



Fig. 9. - Example of Fire  
Ball (Courtesy: FESA)

occurs when a vapour cloud forms from a leak and is ignited, but without creation of significant overpressure. If such overpressure occurs, the event is a vapour cloud explosion (VCE), rather than a vapour cloud fire (VCF).

Release of flammable vapour from a process plant followed by ignition is not uncommon occurrence. If the ignition is prompt, the cloud may be modest in size, but if the cloud has time to spread over an appreciable part of the site and is then ignited, a major cloud fire may result. This occurs in only a very small proportion of ignited release.

In a flash fire, the gas burns, but does not explode. The heat radiation or the flames may cause severe burns. It may also cause sudden depletion of oxygen. When controlled quickly, the flash fire may not cause serious damage to the main plant and equipment, but can extensively damage electrical cables and other vulnerable items of equipment.

In the petrochemical industries, flash fire can occur at collection points, compressor stations, refineries, etc. Industrial flash fire and explosions result from the accidental release and ignition of flammable fuels. The size and duration of the flame that result from this ignition is determined by the amount of fuel available, the efficiency of combustion, and the environmental and physical characteristics of the site of the flash fire or explosion. The temperatures attained by flash fire have been estimated to range from 550 to 1050°C, although higher temperatures are believed to occur. If the flash fire or explosion is sufficiently intense, the heat produced may cause regular clothing to melt or begin burning. Large and destructive vapour cloud fires occurred at Port Newark, New Jersey, in 1951 and at Mexico City, in 1984.

#### **7. FIRE BALLS :**

A fireball burn at about 1400 °C, and are extremely dangerous because of their rate of burn and amount of radiant heat generated. A fireball is inevitable from BLEVE's involving flammable liquids. It is the radiant heat from the fireball that makes the consequences of a BLEVE involving flammable liquids so hazardous. The bulk of the cloud is too fuel rich, so they can only burn around the outer envelope. The cloud will also be lighter than air because of its heat content so that it will lift off to give the appearance of a mini - atomic bomb; complete with mushroom cloud and stem made up of burning fuel reaching up to it from the ground ( See Fig. 9).

*According to Leith Higgins, Principle Scientific Officer of Fire and Energy Services Authority (FESA) of Western Australia*, a BLEVE involving 50 tonnes of LPG would produce a fireball of 200 meters in diameter that would burn for about 14 seconds. During that time it would have a radiant heat content output of about 1, 70,000 megawatts.

There are two types of events, which may give rise to fireball. One is, the ignition of a release on a liquefied gas pipeline, where the jet flame is preceded, by a fireball in which un-ignited gas is burned. The other is an eruption in hot oil giving rise to release of burning vapour.

A distinction needs to be made between fireball resulting from the bursting of a pressure vessel and one resulting from a formation of a vapour cloud. In the first case, the bursting many occur under fire

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conditions and be part of a BLEVE or it may occur in the absence of fire. Momentum forces predominate if a fireball is formed from the bursting of a vessel, and buoyancy forces predominate in one formed from a vapour cloud.

Incidents involving fireballs are not uncommon. They normally occur as part of a BLEVE when vessel ruptures after it has been engulfed in fire or has been subjected to a directed flame. The vessels principally liable to such conditions are storage vessels, rail tank cars, and road tankers.

A massive BLEVE fireball occurred at Crescent City, Illinois, USA in 1970 with an estimated diameter of 150 – 200 m. The diameter of BLEVE fireball incidents at Houston, Texas, USA in 1971; Kingman, Arizona, USA in 1973 and Bet, Montane, USA, in 1976, was about 300m. The disaster at Mexico City, in 1985, involved a series of fireballs from BLEVEs. The estimated diameter of fireballs at Donnellson, Iowa, USA was 610 m.

### 8. VAPOUR CLOUD EXPLOSIONS :

The relative importance of the vapour cloud explosion (VCE) hazard has grown in recent years. Until the early 1980's, a vapour cloud explosion (VCE) was generally referred to as unconfined vapour cloud explosion (UVCE). However, since the combustion of a vapour cloud, the occurrence of overpressure tends to occur due to the presence of structures and obstacles and of partial confinements, the term "unconfined", is now generally omitted.

A vapour cloud explosion is defined as "an explosion of a cloud made up of a mixture of flammable vapour or gas in air". In other words, when a cloud of flammable vapour burns, the combustion may give rise to an overpressure or it may not. If there is no overpressure, the event is vapour cloud fire, or flash fire, and if there is overpressure, it is a vapour cloud explosion.

A vapour cloud explosion is one of the most serious hazards in the process industries. Vapour cloud explosions do occasionally occur and they tend to be very destructive. A feature of vapour cloud is that it may drift some distance from the point where the leak has occurred and may thus threaten a considerable area.

A vapour cloud explosion occurs when a sufficient amount of flammable or combustible material is released, mixes with air and is ignited. When the flammable vapour cloud is ignited, it can explode, producing a blast wave which can cause major destruction at a large distance.

Vapour cloud explosions could be of the two types viz., (1) Confined explosions – these are the ones, which occur within some sort of containment, such as a vessel or a pipe work. Explosions in building also come under this category, and (2) Unconfined explosions – these are the ones in, which the cloud burns in the space or open air, with sufficient rapidity. Normally, the peak pressures of confined explosions are higher and may reach hundreds of kN/m<sup>2</sup>.

The difference between a gas explosion and vapour cloud explosion has to do whether the material is a gas or liquid at ordinary temperature and pressure. Methane and propane would be considered as a gas but fuels such as gasoline, hexane, and cyclohexane are liquids which can



**Fig 10 - On 1 June 1974, a vapor cloud explosion destroyed the Nypro cyclohexane oxidation plant at Flixborough.**  
(Courtesy: isssource.com)



**Fig.11-Houston (Pasadena) Texas 1989 Petrochemical Vapor Cloud Explosion and Fire.**  
(Courtesy:ww.mpri.lsu.edu/workshop/Phillips66Talk.p)



**Fig. - 12 A vapour cloud explosion Devastating fire at the Buncefield oil depot may have damaged the environment for decades.**  
(Courtesy: ziabuzz.com)

vaporise forming a vapour cloud.)

The shape of the vapour cloud before ignition is not spherical but is influenced by wind or air movement and by nearby structures. The fire will burn at all locations where the vapour cloud concentrations are about half the lower explosive limit or higher; however, ignition takes place between the lower and upper explosive limit values.

The peak overexposure within the vapour cloud when ignited probably does not exceed 15 psi above atmospheric. At the edge of the cloud the overexposure is likely to be 10 psi or less. The Table No. 1 gives some of the major industrial vapour cloud explosions.

The term “Unconfined Vapour Cloud Explosion” apparently was carried following the 1st June 1974 accident at a chemical plant near Flixborough. U.K. The accident involved the rupture in a 20 inch bypass pipe dumping almost 40 tons of cyclohexane which vaporized. The resulting vapour cloud found an ignition source; the blast and fire destroyed the entire chemical complex killing 28 people and injuring 89 (See Figure 10).

On October 23rd 1989, a vapour cloud explosion and fireball occurred at the Phillips 66 Petroleum Chemical Complex at Pasadena near Houston, Texas, killing 23 workers, one worker missing and injuring more than 130 others, (See Figure 11). The accident was investigated by the

Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency and other agencies. According to OSHA report, the vapour cloud resulted as a sudden gas release of an estimated 85,000 lbs of a flammable gas mixture (hydrogen, ethylene, hexane, and isobutylene) through an 8 inch open valve. The vapour cloud (estimated to be roughly 1100 feet long, 800 feet wide, and 5 feet high) drifted downwind for about 90 to 120 seconds before contacting an ignition source. The vapour cloud plus additional flammable gas inside tanks at the valve source exploded with a force equivalent to 2.4 tons of TNT based on blast damage. Windows were shattered and bricks were ripped out in an administration building 0.5 miles away. Fragments were thrown as far as six miles away.

Another major conflagration caused by a series of explosions on 11 December 2005 at the Hertfordshire Oil Storage Terminal, Buncefield in England with a capacity of about 60, 000,000 imperial gallons fuel. The first and largest explosion occurred near tank 912 which led to further explosions which eventually overwhelmed 20 large storage tanks. The explosion measured 2.4 on the Richter scale. The incident described as the biggest of its kind in peacetime Europe (See Figure 12) and certainly the biggest such explosion in U.K. since 1974 Flixborough disaster.

### **9. BOILING LIQUID EXPANDING VAPOUR EXPLOSION (BLEVE) :**

The term ‘BLEVE’ is an acronym for boiling liquid expanding vapour explosion coined by three Factory Mutual (FM) researchers viz.: James B Smith, William S Marsh, and Wilbur L Walls. BLEVE has been defined and explained by various experts and some of them are quoted below: Wilbur L. Walls while working with NFPA made many presentations on BLEVEs. According to Walls “for a BLEVE to occur, the container has to be under pressure, the pressure has to exceed the strength of the



**Fig. 13 - Example of a Boiling Liquid Expanding Vapour Explosion (BLEVE)**  
(Courtesy: gas-risk.blogspot.com)

container, and the container has to be weakened in some way (impact, corrosion, fire)". Walls further claims that BLEVEs occur with many types of liquefied gases, flammable and non flammable.

A Michael Birk, a professional engineer and a professor with Queens University at Kingston, Ontario, Canada, hold the view that a BLEVE occurs when a vessel holding a pressure liquefied gas fails catastrophically. According to Birk, "a BLEVE is a physical explosion of compressed vapour and rapidly vaporizing liquid. Upon vessel failure the vapour space sends out a shock wave from the liquid flashing to vapour. If the material is flammable, a fireball may follow it (See Fig. 13). The rapid explosion can also cause projectile effects."

In the General Hazardous Materials Behaviour Model by Ludwing Benner, the BLEVE would be considered as a 'release event' as a result of the container's failing. According to Benner, the magnitude of the release depends on the characteristics of the product, the state and quality of the product, the flow or release rate, the propulsion force, and even whether conditions.

David Lesak, a nationally known hazardous materials author, lecturer, and course developer, defines a BLEVE as a pressure release from catastrophic container failure. The result of a BLEVE is total devastation to the immediate area with potentially large loss of life and property. The size of the BLEVE is dependent on the size and weight of the container along with the amount of liquid that remains inside the container at the moment of the BLEVE. Generally speaking, the bigger the container, the bigger the BLEVE.

BLEVE is an explosion caused by the rupture of a vessel containing a pressurised liquid above its boiling point. A BLEVE is a combination of fire and explosion with an intense radiant heat explosion within a relatively short time interval. In other words it is used to describe the sudden rupture of a vessel system containing liquefied flammable gas under pressure due to flame impingement. The pressure burst and the flashing of the liquid to the vapour, creates a blast wave and potential missile damage. It also results in immediate ignition of the expanding fuel - air - mixture leading to intense combustion, which ultimately results in a fireball.

The phenomena of BLEVE can occur within a vessel or a tank, in which a liquefied gas is kept above its atmospheric boiling point. If the pressure vessel fails as a result of a weakening of the structure, the contents are instantaneously released from the vessel as turbulent mixture of liquid and gas, expanding rapidly and dispersing in air as a cloud.

When this cloud is ignited, a fireball occurs, causing an enormous heat, radiation intensity within a few seconds. This heat intensity can cause several skin burns and deaths at several hundred meters from the vessel depending on the quantity of the gas involved. A BLEVE can therefore be caused by a physical impact on a vessel or a tank which is already over-stressed or damaged. It can also be caused by fire impinging upon or engulfing a vessel and thus weakening its structure.

Thus the essential features of a BLEVE are: (1) the vessel fails (2) the failure results in flash - off of vapour from the super heated liquid and (3)

if the liquid is flammable, the vapour ignites and forms a fireball. The effects are: (1) BLEVE (2) fragments and (3) for flammable liquids, a fire ball. The BLEVE create an over pressure. The phenomena associated with this are: (i) the expansion of this vapour (iii) for flammable liquids, the combustion of the vapour. These events are not completely simultaneous, but have been measured as separate effects. A BLEVE usually generates missiles. There may be fragments created by the rupture event and also the body of the vessel itself. The pressure at the instant of burst is high and the reaction force is often large enough to cause the main part of the vessel to rocket. A BLEVE arising something from the fire engulfment of a vessel containing a flammable liquid also gives rise to a fireball.

Although most BLEVEs involve a liquid, which is flammable, this is not a necessary feature of a BLEVE. Even rupture of a vessel containing super heated water can constitute a BLEVE. Likewise, although engulfment in fire is the common cause of BLEVE, it too is not a necessary feature. Any rupture of a vessel containing a superheated liquid may be traced a BLEVE. The events that can lead to a BLEVE are : (1) Fire exposure, (2) Vapour space explosion, (3) Overpressure (4) Mechanical damage, (5) Collisions, (6) Overfilling, (7) Runaway reactions, (8) Overheating and, (9) Corrosions. The highest frequencies of BLEVE incidents were due to explosions and damage to tanks. Explosion and damage BLEVE incidents resulted in high injuries. Overfilling and fire BLEVE incidents resulted in high fatalities.

Over the years many BLEVE's have occurred and have taken many lives including fire fighters. Some of the BLEVE incidents are outlined below:) The BLEVE at Feyzin refinery in France on January 1966 has received particular attention. In this accident an operator when drawn water from the bottom of a propane sphere control, a vapour cloud formed, ignited and flashed back to the vessel. The pressure in the vessel rose and the relief valve lifted, but the metal of the vessel lost strength and some 90 minutes after ignition the vessel burst. The accident killed 18 and injured 81 people and caused the destruction of five of the spheres.

There have also been instances where release from one storage vessel has led to a fire which has caused BLEVE of an adjacent one such as the case at Texas city, Texas in 1978, where overfilling of an LPG sphere led to a fire which caused the BLEVE of an adjacent sphere which resulted the death of 7 and injury of 10 people. In another case BLEVEs have occurred due to engulfment in a vapour cloud fire.

Such a fire occurred at Port Newark, New Jersey, in 1951 and led to the destruction of over 73 horizontal bullet tanks, many by BLEVE.

Engulfment in a vapour cloud fire was also the cause of destruction, largely by BLEVE of 6 storage spheres and 48 horizontal cylindrical vessels holding LPG at the PEMEX storage (bottling) plant at Mexico City, on 19th November 1984, which killed 650 people and injured about 7000 (See Fig. 14.)

BLEVES also happen in transport, when flammable material is released and ignited following an accident, so that transport tank cars, often when a jet flame from the relief valve on one tank has played on another.



Fig. 14 - In the San Juanico Disaster (Mexico), 54 of these spherical type LPG containers exploded into huge fireballs (Courtesy: <http://en.wikipedia.org>)



Fig. 15 - Example of BLEVE  
(Courtesy: arshadahmad.  
wordpress.com)

A derailment of rail tank cars at Crescent City, Illinois in 1970 caused a release of propane, which led to a fire and caused a succession of tank car BLEVE's. The BLEVE's were accompanied by, large fireballs and missiles, including rocketing tanks (See Fig. 15).

The three BLEVE's occurred at Albert - City, Iowa in April 9, 1998, Burnside, Illinois in October 2, 1997, and Ste. Elisabeth de Warwick, Quebec, Canada in June 27, 1993, was investigated by National Fire Protection Association (NFPA), USA. The NFPA Team, who investigated these accidents, made many observations. According to them in each case, the propane was used to heat building. In each case the tank's relief valves were operating when fire fighters arrived, but they could not stop flames from impinging on the tanks and weakening the tank shells. And in each case, tanks ruptured in BLEVE's that sent pieces of metal flying at high velocities in random directions, killing those caught in their path. Further, when a BLEVE occurs, debris may travel hundreds of feet, with tremendous force, and the escaping fuel can ignite causing an expanding fire ball. Fireballs several hundred feet in diameter are not uncommon, and deaths from burns have occurred to persons as much as 250 ft from the larger containers. The size of a BLEVE depends upon the weight of the container pieces and upon how much liquid vaporizes when the container fails. Generally speaking, the bigger the container, the bigger the BLEVE.

The BLEVE Incident Simulator (BIS) software developed with the help of Dr. A. M Birk will be a very good guide for those who want to know more about BLEVE.

#### **10. CONCLUSION :**

There are several forms of fires and explosions. Jet fires or flames; have been involved in a number of accidents. A large jet flame may have a reach up to 50 m or more. A pool fire can take place in a storage tank and in a bund. The characteristics of pool fire depend on the pool diameter. A flash fire occurs when a vapour cloud forms from a leak and is ignited without creation of significant overexposure. The most dangerous and destructive explosion in the chemical process industries are vapour cloud explosions. Vapour cloud explosions and fires are responsible for most of the largest property loss events world wide. A BLEVE occurs with many types of liquefied gases, flammable and non flammable. The size of the BLEVE is dependent on the container and the bigger the container, the bigger the BLEVE's. A fireball occurs as a part of BLEVE when vessel ruptures and generally occurs on storage vessels, rail tank cars and road tankers. Over the years many BLEVE's have occurred and have taken many lives including fire fighters. India has witnessed several devastating fires, explosions and toxic releases which not only claimed the life of hundreds but also huge property loss. In spite of the existence of the National Building Code of India and several fire safety regulations enacted by various state governments and local bodies, the fires and explosions are mounting day by day through out the country. Hence, sincere efforts are to be made by one and all to prevent the fire and explosions in the country.

## **WorkCover Moves against Draytons**

**WorkCover NSW has launched criminal proceedings against Drayton's Family Wines at Pokolbin, north-west of Newcastle, over the fatal 2008 explosion that killed prominent winemaker Trevor Drayton and boilermaker Eddie Orgo.**



Photo: ABC.net.au

**More than 18 months after a coroner found poor safety measures at the family-owned winery were a major cause of the blast, WorkCover has confirmed it has lodged an indictment in the district court against W Drayton and Sons Pty Ltd, trading as Drayton Family Wines.**

**It follows the completion last month of WorkCover's investigation into the incident and the coroner's findings, and presents another painful blow to the Drayton family.**

**Directors of the company at the time of the blast were Trevor's father Max and his brothers Greg and John. WorkCover's move means the trio is accused of causing the negligent manslaughter of their son and brother, as well as Mr. Orgo.**

**For legal reasons, WorkCover was unable to detail the charges yesterday but the Herald can confirm they relate to the alleged failure to ensure the safety of workers at the family's Oakey Creek Road vineyard.**

**In this case, such a breach equates to two charges of negligent manslaughter, leaving the company open to fines of up to \$1.65million. Individuals face fines of up to \$165,000, or five years in jail.**

**The explosion occurred on January 17 in 2008 when Mr. Orgo began welding a steel tank which he was unaware contained 9000litres of SVR, a spirit similar to ethanol.**

**The explosion blew the roof off the tank along with much of the production area's roof.**

**Mr Rikard-Bell ran to a nearby dam to extinguish the flames that engulfed his body.**

**Witnesses told the coronial inquest that two smaller explosions followed the first blast and that they saw liquid running through drains which had caught alight.**

**At the time, John and Greg Drayton were working in other parts of the vineyard.**

**Following the inquest, John Drayton said his family appreciated the understanding shown by the coroner, and expressed his sympathies to the family of Mr. Orgo and to Mr Rikard-Bell.**

**"Our family hopes that positive changes can come about as a result of the coroner's findings so that Trevor and Eddie's tragic deaths and Will's injuries were not in vain," he said at the time.**

**The matter is listed for mention in the district court later this month.**

**Source: Jason Gordon, Newcastle Herald**

**Inquest:**

**[http://www.coroners.lawlink.nsw.gov.au/agdbasev7wr/assets/coroners/m40160114/43\\_drayton&orgo.pdf](http://www.coroners.lawlink.nsw.gov.au/agdbasev7wr/assets/coroners/m40160114/43_drayton&orgo.pdf)**



Photo: news.com.au