Major Loss: Explosions

IFIC FORENSICS

This factsheet considers the nature and causes of explosions and provides insights into the investigation of explosion claims.

Each year the UK sees a small number of explosions, which by their very nature are high profile events which feature prominently in the local, national and occasionally international media.

Often the most shocking of these events are those associated with terrorism as their main intention is to shock through the destruction of property and the death and injury of usually innocent bystanders. Invariably, such events are investigated by the Police and Security Services with specific details of the methods used remaining confidential for reasons of national security.

Less contentious, but often equally as devastating are those explosions involving mains services and industrial processes, which have the potential to create far greater damage.

An extreme example of this is the devastating explosion at a chemical plant in Flixborough, in North Lincolnshire in 1974. The blast killed 28 people, a toll that would have been much higher if it had occurred on a weekday, when many more staff would have been present. The blast occurred through the ignition of a leak of Cyclohexane, a hydrocarbon fuel. In addition to fatalities, there were 36 injuries onsite, a further 50 off site and damage to 2000 properties.

Arndale Centre Bombing, Manchester

Chemical Plant Explosion, Flixborough

WHAT IS AN EXPLOSION?

The term explosion refers to “a rapid increase in volume and release of energy in an extreme manner”. Explosions can be mechanical, which is when high pressure gases produce a physical reaction such as when a rupture or failure of a vessel occurs. Examples of mechanical explosions include overheated boilers or the failure of heated cylinders. These are known as ‘Boiling Liquid Expanding Vapour Explosions’ or BLEVE’s and are often symbolised by a high degree of structural damage, but (dependant on the composition of the vapour) the lack of accompanying fire damage, unless of course the liquid is a combustible liquid.

Alternatively, explosions can be chemical, which generally involves a rapid and violent oxidation reaction, which produces large amounts of hot gas and extreme temperatures. Such explosions are often identified by intense flame and light production, followed by a resulting blast wave which results in wide spread structural damage, followed usually by a continuing severe fire. The explosions are also characterised by tremendous noise created by the blast. The explosion at the Buncefield Oil Storage Terminal in December 2005, was reported to be the biggest peacetime explosion in Europe, measured at 2.4 on the Richter scale and with the blast being heard up to 125 miles away in Belgium, France and the Netherlands.

Oil Storage Terminal Explosion, Buncefield

Explosions can be classified further as Detonations and Deflagrations. A detonation is an event in which an initial explosion (detonator) initiates a secondary, much larger explosion creating a supersonic blast wave. These explosions usually involve materials like Trinitrotoluene (TNT) or Pentaerythritol Tetranitrate (PETN) which are more associated with military use or industries such as mining. The availability of such materials is highly controlled.

A deflagration is subsonic combustion propagating though heat transfer. This is the extremely rapid transfer of heat, i.e. hot burning material heats the next layer of cold material and ignites it and so on. This process can take seconds, or even fractions of a second.

Dust explosions are the rapid combustion of fine particles suspended in the air. They can occur where any dispersed powdered combustible material is present in high enough concentrations in the presence of an oxidiser, such as atmospheric air. They are a frequent hazard in coal mines and grain elevators and generally require the disturbance of the material to cause it to be in suspension in the presence of an ignition source. Materials such as coal, sawdust, flour, starch as well as powdered metals such as aluminium and magnesium can all form explosive mixtures when suspended in air, if finely divided.

CAUSES OF EXPLOSIONS

Explosions can be caused through numerous reasons, including but not restricted to; industrial process failures, improper maintenance, undetected corrosion, component failures, poor workmanship, careless smoking, hot work, recklessness and sabotage.

Explosions related to failures to maintain and poor workmanship can often lead to prosecutions under Health & Safety legislation.

In terms of industrial risks, the Control of Major Accident Hazard Regulations 2015 (COMAH Regs) provide regulations to establishments storing or handling large quantities of industrial chemicals of a hazardous nature. Typically, these are chemical warehouses, distributors and chemical producers.

The regulations require establishments to produce safety reports which demonstrate the measures taken to minimise risks posed by the site with regard to the environment and local populations.

GAS EXPLOSIONS

A more frequently encountered type of event is the domestic gas explosion. These unfortunately are not rare events. Each year seems to see a number of domestic properties and often multiple properties laid low by virtue of what eventually are identified as explosions involving leaks of mains gas. This type of event often occurs during the coldest seasons of the year when gas usage is at its highest.

The reasons for such gas explosions are varied and can be related to faulty heating appliances, failures in gas lines and the disturbance of gas appliances resulting in the loosening of connections leading to leaks. All too often however, the failure is related to poor workmanship leading to homelessness, shock, injury and occasionally loss of life.

Domestic explosions can involve LPG but more commonly natural gas. The significant difference is specific gravity, i.e. that LPG is heavier than air and because it settles in lower areas, this often results in total destruction of properties. Natural gas is lighter than air and therefore rises when released in buildings. Typically, explosions involving natural gas result in high level damage and the loss of roofs.

It should be noted that gas/air explosions require the gas/air mixture to be within flammable limits. That means the percentage mixture of the gas/vapour in air that will allow combustion to take place. Too high a percentage will create a too rich mixture and too low, a too lean mixture.

Typical flammable range values are:

Natural gas 5% - 15% in air

Butane 1.8% - 8.4% in air

Propane 2.1% – 9.5% in air

EXAMPLES OF THIRD PARTY LIABILITY

In November 2010, a gas explosion ripped through a house in Irlam, Greater Manchester. The house and neighbouring properties were completely destroyed, with up to 200 other properties affected. 14 people were taken to hospital, with one elderly lady suffering 30% burns.

Full emergency planning procedures were put in place to deal with the scores of residents evacuated by the incident and accommodated in emergency shelters for a number of weeks.

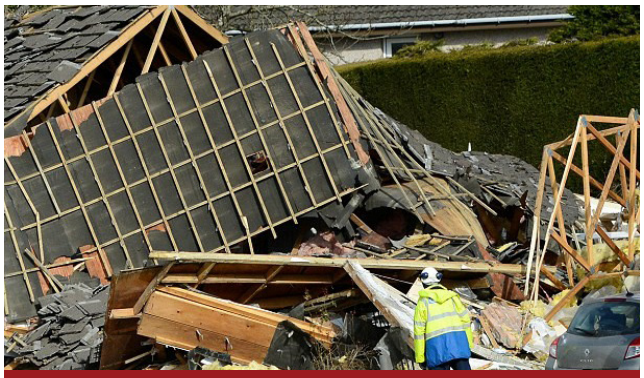
Following an extensive investigation by Police, Fire Service and the HSE, a workman was fined for breaches in gas safety regulations. It was stated that his substandard work on a gas meter could have contributed to the explosion.

Domestic Gas Explosion, Irlam

IFIC Forensics was involved in the investigation of a similarly devastating domestic gas explosion in 2013 in a detached bungalow in Callander, Perth. The house was levelled, and the elderly occupants were trapped in the rubble having to be rescued by firefighters.

A plumber had been carrying out work on a gas boiler some eight months before the fire. Typically, neighbours and family members reported a smell of gas in the days before the explosion. The explosion occurred when the residents were making tea.

The plumber was found guilty of installing the boiler dangerously, which involved a defective connection, that eventually led to a leak of gas, calculated to be 9 cubic metres per hour. When mixed with air, this caused the explosive mixture. The plumber was fined £3000.



Domestic Gas Explosion, Callander

INVESTIGATING EXPLOSIONS

The investigation of explosions follows many of the standard procedures for investigating fires. The usual data gathering processes are employed, such as examining patterns of damage, speaking to witnesses, observing CCTV, reviewing documentary evidence, etc. Scene recording procedures are also equally as important.

However, the investigation of explosions has many unique features, which can have a dramatic effect on how the investigation progresses, such as:

- The suspicion of criminal activity may mean the scene is cordoned off and in the control of the Police for many weeks, even months, until that suspicion is eliminated.
- Even then, investigations by the HSE into possible non-deliberate but criminal breaches of safety regulations may restrict access to site, evidence and witnesses.
- Evidence may have been projected hundreds of metres from the point of the explosion.
- Witnesses may be detained in hospital or even deceased.
- There is almost always a requirement for multi-agency working.
- Where hazardous materials are involved, there maybe areas that require decontamination before investigators can enter.
- Significant structural damage may mean that areas of the scene are at least initially inaccessible until controlled demolition is possible.
- The high-profile nature can mean high levels of interest from the media.

Insurers, claim handlers and loss adjusters need to be kept informed of these factors and the potential for a protracted investigation.

We recommend the instruction of forensics at the earliest opportunity as data gathering, even off site, should commence as soon as is practicable. Forensic investigators will liaise with the other agencies involved and keep those instructing them appraised of developments.

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