Making Process Safety personal

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The LyondellBasell site at Carrington uses several techniques to achieve the same focus on process safety as on occupational safety. The main aims are to make process safety as personal as possible and use all possibilities to emphasise barrier management.

A high level of Process Safety near misses is reported. Hypothetical scenarios have been developed based on combining a number of these actual near misses into hypothetical events which could be catastrophic if they occurred. The aim is to foster a sense of unease by showing the possibility of such events if several barriers fail and thus the importance of each individual barrier.

Quarterly Process Safety newsletters are issued to all personnel providing reminders of previous incidents within industry as a whole and within the company. Articles are also included as refreshers of the hazards of different fluids and updates of process safety improvement projects.

On significant anniversaries of major incidents, reminders are sent to everyone on site with an overview of the incident including the underlying causes of the barriers which failed.

Process Safety Tool Box talks are carried out on all the above subjects, with sharing of topics across company sites for discussions with operating and maintenance technicians.

Under the general Process Safety theme of ‘Lives and Livelihoods’, a newsletter was produced based solely on process safety hazards in the home including LPG storage & handling, prevention of gas leaks, flammable hazards of clothes driers, smoke and carbon monoxide detection and emergency planning.

Keywords: Process Safety, Personal, Barriers, Theoretical Scenarios, Newsletters, Tool Box Talks.

Introduction

Historically, companies have concentrated their safety management culture more on Occupational Safety than on Process Safety.

LyondellBasell corporate HSE philosophy is ‘Goal Zero’ where the aim is to prevent incidents and injuries.

LyondellBasell has increased the level of focus on Process Safety at a corporate level and the Basell Polyolefins UK Ltd. site at Carrington (part of the LyondellBasell group) uses several techniques to achieve the same focus on process safety as on occupational safety. The main aims are to make process safety as personal as possible and use opportunities whenever possible to emphasise barrier management, under the general Process Safety theme of ‘Lives and Livelihoods’.

Development of Scenarios from Near Misses

A high level of Process Safety near misses is reported, with the site reporting the highest number of process safety near misses per person within the whole company.

Hypothetical situations have been developed based on combining a number of these actual near misses from a range of equipment across site at different times leading to hypothetical scenarios which could be catastrophic if they occurred on the same equipment at the same time. The aim is to foster a sense of unease by showing, from real near misses, the possibility of such events if several barriers fail at the same time and thus the importance of each individual barrier.

Two such hypothetical situations leading to similar consequences to site COMAH Key Scenarios are as follows:-

(a) BLEVE of Reactor Vessel (see Figure 1)
   - C3= Pump Cavitates
   - Pump Doesn’t Trip
   - Leak from Incorrect Gasket
   - ROSOV Seizes
   - Jet fire created
   - Auto Deluge Valve Fails
   - Fire pump fails
   - Evacuation Alarm Confusion
   - Fireproofing missing
   - REACTOR BLEVE
Figure 1: Hypothetical Reactor BLEVE Scenario

(a) LPG Storage Sphere Overfill Leading to Explosion in Temporary Building (see Figure 2)
- Sphere undergoing Maintenance
- Corrosion Found delaying re-commissioning
- Ship waiting to off-load at Jetty
- Interlock Broken
- Flow Trip Fails
- Level Trip Awaiting Spares
- Actuator Seizes
- RV to Flare undergoing Test
- RV to Atmosphere Lifts
- Gas drifts towards temporary building
- Confusion from contractors about the correct emergency response
- EXPLOSION WITHIN PORTACABIN

Figure 2: Hypothetical LPG Sphere Overfill Scenario

Process Safety Newsletters
Quarterly Process Safety newsletters are issued to all personnel (including term contractors) to communicate important Process Safety information such as reminders of previous incidents within industry as a whole and within the company. Articles are also included as refreshers of the hazards of different fluids and updates of process safety assessments and improvement projects. Tool box talks are held with each operating shift team (and where applicable the maintenance team) to discuss the content face-to-face and allow detailed questions about the issues involved. On many occasions this leads to useful discussion and information being received which may not be known by engineers,
Articles about the causes and relevance for Carrington site have been written about the following Major Industrial Incidents:-
- Imperial Sugar, Georgia
- San Juan, Mexico City
- Icmesa, Seveso
- Shell, Moerdijk
- AZF, Toulouse
- Phillips, Pasadena
- BP, Texas City
- Esso, Longford
- Formosa, Texas
- Union Carbide, Bhopal
- Nypro, Flixborough,
- Occidental, Piper Alpha
- BP, Grangemouth
- Hertfordshire Oil Storage, Buncefield

Articles have been written about the following Process Safety Initiatives:-
- Minor Incidents at Site and their root causes
- Incidents at Sister plants
- Accidents at plants within the same Technology
- Filter switching incidents
- Incidents generating Chlorine clouds from incorrect water treatment chemical offloading
- Annual Summary of most important Site near misses
- Plant re-Hazoping
- Human Factors Risk Assessments
- Occupied Buildings Assessments
- SIL Assessment update
- Alarm Management update
- Hazardous Properties of Materials on Site (Peroxide temperature sensitivity, Nitrogen Ashphxyiation, Ethylene Decomposition)
- Low Temperature Embrittlement
- Corrosion Under Insulation
- Safety Critical Tasks
- Safety Critical Equipment
- Process Safety improvement projects implemented
- Contractor initiatives
- COMAH report updates
- Risks from Adjacent sites
- Review of Level 5 COMAH exercises with authorities

Examples of these newsletters are shown below:-

Welcome to the first issue of the Carrington Process Safety News, a quarterly newsletter that covers process safety initiatives and the particular group endeavours about process incidents and their causes at Carrington, within the company and in the wider industry.

This newsletter is intended to be a reminder to employees to take care while handling chemicals and to instil a culture of safety within the company.

The aim of this newsletter is to provide information on the latest developments in the field of process safety, including recent incidents, initiatives, and best practices. It is hoped that this newsletter will help to raise awareness of the importance of process safety and encourage a culture of safety within the company.

Please take the time to read this newsletter and share any feedback or suggestions with your supervisor or manager. Your insights and contributions will help to improve our overall process safety performance.

Thank you for your dedication and commitment to process safety.
**Corrosion under insulation**

- The Carrington LIPP plant uses Trigonox as a cracking agent. This peroxide is highly exothermic and can cause catastrophic failure of equipment or a fire/explosion if liquid for C3= or C2= to condense in other systems e.g. HP Bag Filter or Ethylene pipeline. As discussed in the recent ethylene hazards training, prevention of liquefaction of hydrocarbons in normal CS systems is key to preventing such incidents. If liquid forms, accelerates Decomposition

- A Looped Flow of N2 gas can be introduced into the bag filters to prevent CUI. The gas can be introduced through a constant flow valve and be adjusted as needed. A cut-out is provided in the gas supply system to allow the gas flow to be reduced to zero and then restored to the desired value.

- There has been temporary MOC's completed at Carrington during the last 12 months as follows:
  - Temporary 28 psi operation
  - MOC Level 2 for Recycling Compresor 3B Pn - this is to allow the compressor to be run at 3B psig. This has been approved by the RXM management and is to be reviewed after 3 months. The future condition states clearance. The decision was to proceed but not to accept the risk. The recommendation was to inspect the 28 psi operation to ensure that it was a safe operation.

- This type of barrier is designed to prevent CUI. It is probable that some people in parts of the plant could not hear the warning sign.

- The decision was to provide a barrier to prevent CUI. This was considered to be the most effective way to prevent CUI. The decision was made to provide a barrier to prevent CUI. This was considered to be the most effective way to prevent CUI.

- The systems being provided with DBB's as part of this project are:
  - Peeb kill valve failure (Safety Critical Task for response to an upset)
  - Provide Double Block & Bleed Isolations on Critical Items

- The systems will be installed in a step by step basis to allow some people in parts of the plant to also see the signs when they are in the plant.

**Process Safety Project Update**

- Process Safety Management (PSM) is a requirement of the Health and Safety Executive (HSE) in the UK. The aim of PSM is to identify and control the hazards associated with the processing of hazardous substances. This is done in order to prevent accidents and protect people and the environment from harm.

- The systems will be installed in a step by step basis to allow some people in parts of the plant to also see the signs when they are in the plant.

**Liquid Propylene in HP Bag Filter**

- Propylene is a hazardous substance that can cause serious injury or death if inhaled, swallowed, or absorbed through the skin. It is a highly flammable gas and can react explosively with oxygen. Exposure to high levels of propylene can cause symptoms such as headaches, dizziness, and drowsiness. In severe cases, exposure can lead to unconsciousness and respiratory failure.

- The systems will be installed in a step by step basis to allow some people in parts of the plant to also see the signs when they are in the plant.

**Nitrogen Hazards**

- Some chemicals can cause severe injury or death if inhaled, swallowed, or absorbed through the skin. These chemicals are considered to be hazardous because they can cause immediate or long-term health effects. Examples of hazardous chemicals include propylene, nitrogen, and argon. Exposure to these substances can cause symptoms such as headaches, dizziness, and drowsiness. In severe cases, exposure can lead to unconsciousness and respiratory failure.

- The systems will be installed in a step by step basis to allow some people in parts of the plant to also see the signs when they are in the plant.

**SIL Assessment Update**

- SIL (Safety Integrity Level) is a measure of the performance of a safety instrumented system. It is used to determine the level of risk reduction that can be achieved by a safety instrumented system. The higher the SIL, the lower the risk of failure.

- The systems will be installed in a step by step basis to allow some people in parts of the plant to also see the signs when they are in the plant.
Beginning of 2014, a team has been re-educating employees at the Carrington site about the importance of proper solvent flush of filters. This is due to problems with one of the filters not being properly flushed, which can lead to potential safety hazards. The team has been working closely with the Chemical Safety Board to ensure that proper procedures are in place to avoid future incidents.

The Hazop aims to identify hazards and their consequences, which is crucial in ensuring the safety of the plant. In the past, there have been several gas explosions in houses in the UK in recent years, which have caused significant damage and loss of life. As in the plant, we probably think about Personal Safety when we are doing jobs at height, but there are other items of equipment which can cause fires and explosions. For example, there are certain items of equipment which are Critical to Safety. The air is dosed at the correct flowrate during and for some time after the completion of products. The main air flow will be injected to the cone of the silos, with a smaller flow (so as not to diffuse at a reasonable rate in the run up in vents from driers and fires etc. when doing safety walks? Recently, we have seen dust accumulations in our day jobs and be catastrophic for you and your family if one happened? Are you aiming for Goal Zero for you and your family?

SILO DEGASSING PROJECT

The project aims to implement a technique to degas stored products such as nitrogen and butanol which remain in the pellets leaving the extruder. In the plant, we all know that early detection and isolation of hazards is essential. In our plants, we are ever vigilant about the potential for Loss of Containment. Told you that I had a fault which could cause a fire. Luckily the previous owners had responded to the incident by isolating electricity, wearing safety glasses and personal protective equipment. This incident caused the evacuation of the employees who were trying to clear a blockage in the outlet line of the decomposer vessel. This caused a major explosion which could be heard 50 miles away. The investigation determined that, on average more than 400 people die at work each year in the US. The US Chemical safety Board determined that, on average more than 400 people die at work each year in the US. The problem occurred as a result of the combination of significant changes over a period of time. A simple task has been transformed into a complex task by being handed over to someone else. In the Plant Re-Hazop update, we are focusing on the implementation of this technique to degas stored products and the potential for Loss of Containment.

Remembering the Past

On significant anniversaries of major incidents, reminders are sent to everyone on site with an overview of the incident including the underlying causes of the barriers which failed.

Examples of such reminders are as follows:

- San Juan, Mexico City
- Icema, Seveso
- Phillips, Pasadena
- BP, Texas City
- Esso, Longford
- Formosa, Texas
- Union Carbide, Bhopal
- Nprof, Flixborough,
- Occidental, Piper Alpha
- Hertfordshire Oil Storage, Buncefield
- Vessel explosion at Predecessor company site.
- Filter leak leading to Explosion and Fire at Predecessor company site.

A reminder was also issued to site on each anniversary (now the 6th) of the most recent Level 2 leakage of flammable material on the Carrington site, to remind everyone of this previous event and prevent complacency due to no significant incidents having occurred at site for quite some time.

**Process Safety Tool Box Talks**

Process Safety Tool Box talks are carried out on all the above subjects, with sharing of topics across company sites for discussions with operating and maintenance technicians. Tool Box Talks are also held with each operating team following the publication of each Process Safety Newsletter.

Examples subjects include
- What’s in the tanker?
- Flare systems
- Instrumental Safeguarding
- Mechanical Safeguarding
- Corrosion Under Insulation
- Human Factors
- Dust Explosions
- Earthing and Bonding to prevent Ignition Hazards

**Process Safety Plant Auditing**

Plant safety auditing has been in place at site for decades. In recent years, the site has increased the focus on Process Safety in plant auditing as follows:-

- All Safety Critical Tasks have a ‘Walk-Through-Talk-Through’ audit annually by management. This covers a detailed discussion through all the safety critical aspects of the critical task in the control room or workshop to check the technicians understanding of the procedure and why it is critical to process safety, checking the procedure itself is accurate, clear and up-to-date and reviewing the steps which would be taken. The procedure is then followed through at the workplace (usually within the plant or workshop) to ensure that it is fit-for-purpose and that all steps are carried out as per the procedure in reality.
- Process Safety is included in all plant safety walks and an Aide-Memoire for Process Safety topics has recently been published for staff participating in the safety walks. Both safety walks and management inspections have aide-memoires based on process safety to sample different topics and proactively go ‘looking for problems’ before issues potentially become more severe.

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Process Safety in the Home

One newsletter was produced based solely on process safety hazards in the home with the following text:-

We all know about process safety in the plant, but have you thought about Process Safety in the home? Here are some examples:

Toxic Gases: In our plants around the world, we have the possibility for the release of toxic gases (e.g. Ammonia and Chlorine potential at Carrington). In the home, there is the potential for Carbon Monoxide or Chlorine. There is on average 1 person is killed at home every week in the UK and 4000 go to A&E every year with the effects of CO poisoning. A friend of mine and his family almost died some years ago due to a faulty flue. Mixing the wrong cleaning agents with each other (hypochlorite and acid based products as in the plant) can produce chlorine. Do you have a Carbon Monoxide alarm to protect your family? Are your heating appliances regularly tested and serviced?

Flammable Gases: In our plants, we are ever vigilant about the potential for Loss of Containment of gases such as Propylene and Ethylene. In the house, most of us have natural gas supplies. Although the pressure is much lower, the ultimate consequences can be catastrophic. In a typical house, there only needs to be about 5 kg of natural gas to have a flammable mixture through the whole house. There have been several gas explosions in houses in the UK in recent years with many people being killed. Do you know, especially if you have moved house recently, if all your gas appliances have been fitted correctly? Are they regularly tested and serviced?

LPG: Do you have LPG for heating your house or cylinders for a BBQ or garden heaters? It goes without saying that there is quite some potential for things to go wrong. When we were looking to move house last year, we viewed one house where the family was worried about storing 2 LPG cylinders in the garage below the children’s bedroom, so they stored them in the dining room instead! Do you look after LPG cylinders and, if you have one, storage tanks like you would do at work? Are they safely stored and away from children?

Fires in Vents and Flues: There is potential for solids to build up in vents from driers and fires etc. In the Pernis LIPP plant ~ 20 years ago, a serious fire which started in an extract system almost burned down the whole extruder building. This could happen in your house. How often do you check these vents for build-up of flammable material which could set fire to your house?

Fire Detection: In the plant we all know that early detection of a process safety incident can be the difference between a small effect and something which can get out-of-hand and be devastating. We have gas detection, fire detection and smoke detection in many different places in our plants. Did you know that on average more than 400 people still die each year in house fires in the UK? Most of these deaths could be prevented if smoke detectors were fitted in houses. However, like our instrumentation in the plants, it’s not just about having detectors, but we must ensure that they are located in the right place and always working. How often do you test your smoke alarms at home to check that they are working?

Emergency Plans: In the plants, we have detailed emergency plans, train our staff and test the plans frequently, just in case the worst should ever happen. This could be vital at home. If a smoke alarm goes off in the night, does your family, especially children, know what to do (and also what not to do)? How would you raise the alarm, how would you rescue the children, how would you escape?

Equipment Monitoring: At work, there are certain items of equipment which are Critical to Safety. Maybe we don’t think that we have these in the house. We’ve mentioned above about gas appliances and driers, but there are other items of equipment which can cause fires such as washing machines and dishwashers. We read that the dishwasher in the house we have just bought was one which had a fault which could cause a fire. Luckily the previous owners had responded to the safety notice and had the faulty component replaced, but less than 50% of households had done this. Failures of these household appliances can happen at any time. Do you run the washer or dishwasher at night when electricity may be cheaper, or do you leave appliances running when you are out of the house?
As in the plant, we probably think about Personal Safety when we are doing jobs at home because of our training at work (isolating electricity, wearing safety glasses and dust masks, using the right tools etc. etc.), but how many of us really think about the Process Safety type incidents which could happen and be catastrophic for you and your family if one happened?

Are you aiming for Goal Zero for you and your family?

**PROCESS SAFETY IN THE HOME**

We all know about process safety in the plant, but have you thought about Process Safety in the home? Here are some examples:

- **Toxic Gases**: In our plants around the world, we have the possibility for the release of toxic gases (e.g. Ammonia and Chlorine potential at Carrington). In the home, there is the potential for Carbon Monoxide or Chlorine. There is on average 1 person is killed at home every week in the UK and 4000 go to A&E every year with the effects of CO poisoning. A friend of mine and his family almost died some years ago due to a faulty flue. Mixing the wrong cleaning agents with each other (hypochlorite and acid based products as in the plant) can produce chlorine. Do you have a Carbon Monoxide alarm to protect your family? Are your heating appliances regularly tested and serviced?

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