

## OVERVIEW ON INDUSTRIAL MAJOR ACCIDENT HAZARDS CONTROL

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This paper is written based on writers' participation in the seminar on the Industrial Major Accident Hazards Control which was held recently in Kuala Lumpur.

The objectives of the seminar are to create awareness on safety in industries that have the potential to present Major Accident Hazards and to impart to the participants the basic principles of control of these major hazards.

An important concept that should be fully understood first is that safety in industries is very essential and must be incorporated in all steps of establishing those industries. Some of the wellknown steps are site selection, plant layout, plant and equipment designs, etc. Accident is likely to occur if safety measures are neglected in any one of those steps. Safety measures will be briefly discussed in the later part of this paper.

To understand further the concept of safety, let us examine the definition of keywords in the above title. The first keyword is 'Major Accident' which is defined as follows:

An occurrence such as a major emission, fire or explosion resulting from uncontrolled developments in the course of an industrial activity, leading to a serious danger to men, immediate or delayed, inside or outside the establishment, and/or to the environment, and involving one or more dangerous substances.

Industrial activities mean any operation carried out in an industrial installation and such operations should involve dangerous substances and should be capable of presenting major accident hazards.

The other keyword is 'control'. Control can be considered in two time frames, that of after the event where people are fighting to control the outcome of a disaster, and the control that is built-up and established to prevent the accident from happening.

The major hazardous accidents can be classified into seven categories depending on the chemical and physical properties of the material and the type of installation involved.

They are:

1. Boiling Liquid Expanding Vapour Explosion (BLEVE)
2. Confined Vapour Explosion (CVE)
3. Unconfined Vapour Cloud Explosion (UVCE)
4. Detonation (DET)

5. Fire Ball (FB)
6. Release of Toxic Substances (TOX) and
7. Release of Radioactive Materials (RAD)

Preventing and controlling accidents from happening, one needs to understand the underlying and immediate causes that lead to a disaster. There are three main causes, namely:

1. Abnormal Process Condition  
e.g. excess temperature, pressure
2. Interference by Another Activity  
e.g. an aeroplane crashed onto the plant
3. Natural Influences  
e.g. flood, earthquake

Having understood the causes and consequences of major accident hazards, the next step that have to be done is to try to introduce control system that at least will limit those costly consequences into minimal. A major hazards control system must contain four areas of activities, namely:

1. Identification of Major Hazards
2. Assessment and Analysis of Major Hazards
3. Management of Major Accident Prevention System
4. Emergency Operations

## 1. Identification of Major Hazards

Identification followed by careful planning should start from the early stages of installation such as site selection, plant layout, plant design and operating procedures.

Siting policies should be established. This refers to the separation between the installation and the public and control policies that needs to be exerted to stop the public and other development from getting closer to the installation.

The best process plant layout is the arrangement of vessels, piping, conveyors etc. that satisfies the constraints of operation, safety, environmental protection, maintenance and construction for the least cost of the equipment and the most economic use of site or building.

Unlike many industrial activities where different parts of a manufacturing plant are deliberately placed adjacent to each other to minimise interstage transport, most Process Industry sites are laid out with plant units carefully segregated, albeit at some extra cost. Three main considerations lie behind this policy of segregation:

1. Safety and Loss Prevention

- Explosion
- Fire
- Leakage
- Structural Collapse

2. Housekeeping

- Fumes
- Dust

3. Access for construction and maintenance.

Another step of identification is identifying major hazards activities, name and quantity of hazardous material. Finally the management should notify local competent authority about those hazards identifications, location, schedule of start-up and shut-down operation, etc.

2. Assessment and Analysis of Major Hazards

Techniques that are available for assessment and analysis purposes are:

- HAZOP (Hazards and Operability Studies)
- HAZAN (Hazards Analysis)
- Hazards Assessment
- Risk Analysis
- Risk Assessment

### 3. Management of Major Accident Prevention System

In reviewing the management of major hazard installations, Dow Safety Director for Pacific Area, Mr. Brian Hawes mentioned that "total loss dollars" are mainly due to "Natural Causes" such as flooding, Hurricane etc. Whereas "Process Incidents" occur most frequently, but represent a relatively minor part of total loss dollars. He then outlined nine factors which form the underlying basis for the management or control of "industrial major accident hazards". They are:

1. Plant Design
2. Safety Systems in Use
3. Operator Training and Responsibility
4. Start-up and shut down operations
5. Ways by which control of plant can be lost
6. Recordkeeping
7. Housekeeping
8. Maintenance Procedures and Permit to work
9. Procedures for Modifications

### 4. Emergency Operations

#### a) On-Site And Off-Site Emergency Planning

The other factor in ensuring safety in major hazard installations is the availability of "Emergency Operations or Planning". It cannot be considered

in isolation and its proper place is as a back-up to the preventive measures discussed earlier.

The employer bears most of the responsibility for these measures, which can be summarised as follows:

1. ensure that the plant and storage vessels are designed and installed to a good standard and in a location where hazards are unlikely to arise from other plant or buildings nearby.
2. ensure that proper work routines and effective maintenance procedures are set up.
3. assess what could still happen to cause an emergency situation: further preventive measures may still be possible.
4. assess what dangers could arise to people both on-site and off-site as a result of these foreseeable emergencies and how these could be mitigated by pre-planned remedial and rescue measures utilising the resources of the major hazard installations and the public emergency services.

Item (4) will require the formulation of a emergency plan which is in two separate parts: the on-site

plan, covering the action to be taken on the installation and the off-site plan covering the action to be taken in the neighbourhood around it.

b) Formulation of the On-Site Emergency Plan

Employers should set up a plan based on the specific needs of the particular site. All plans would, however, need to maintain the following key elements:

- assessment of the size and nature of the events foreseen and the probability that they might occur
- formulation of the plan and liaison with outside authorities, including the emergency services.
- procedures : raising the alarm and communications.
- appointment of key personnel and defining their duties and responsibilities.
- setting up of emergency control centres.
- action on site : fire-fighting procedures, rescue systems, evacuation arrangements, first-aid arrangements.
- plant shut-down procedures.



c) Formulation of the Off-Site Emergency Plan

The responsibility for setting up this part of the plan should lie with the public authority that has control of resources and facilities in the neighbourhood of the installation. Since the employer will possess detailed knowledge about his plant and substances, he should pass it on to the public authorities to enable them to draw up the off-site plan. Thus, the on-site and off-site plans should complement each other.

In addition, the employer will need to advise the neighbouring community either directly or through the public authorities as to the nature of the hazards involved and the action to be taken in the event of an emergency.

Experience has shown that in real emergencies there is often much confusion, no matter how well the plans are drafted. It is essential, therefore, that plans are regularly rehearsed and practised under simulated emergency conditions in order to test the response of operators and emergency services personnel, test and evaluate the interaction of the various organisations involved, evaluate the effectiveness of equipment and increase gains from experience.

Finally, in preventing major industrial accident, it is better to spend money at the early stages so that no major modifications would have to be made due to unsafe operations. Furthermore, all employees, irregardless of their positions, should be sensitive and committed to the safety aspect of their industry. As such, it is good to have a "safety Induction Program" for all new employees so that they are always aware of the needs for safety.

#### Situation in Malaysia

Jabatan Kilang dan Jentera Malaysia had done a survey on the hazardous installations in 1985. From the survey, 83 major hazards industrial installation were identified. More than half of these are located in an area classified as non-industry viz comprising of schools or residential area or public places. The survey also revealed that 38 - 58% of the owner of those sites were not aware of HAZOP and did not carry out HAZOP studies and risk analysis. 42% of these sites did not carry out rehearsal for their on-site emergency. 61% was found not having emergency plan for their neighbours (off-site emergency plan).

The International Labour Organization (ILO) has compiled all major accidents hazards. It is

reported that the highest frequency accident is involving Liquid Natural Gas (LNG) and Liquid Petroleum Gas (LPG). Malaysia currently is moving towards LNG and LPG utilization for the public and industrial needs. Looking at the terrifying statistic from the JKK's survey and the mounting hazardous potential of LNG and LPG, there are still alot more to be done in Malaysia to ensure safety to the workers, public and the environment in years to come. One thing for sure, Malaysians would certainly do not want to see accidents that claimed so many lives and properties to happen in Malaysia, such had happened in Mexico City in 1984 which claimed 650 lives and several thousands injured as a result of an LPG explosion.

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