LEARNING FROM LOSSES

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ABSTRACT

Fire incidents cause both loss of lives and financial losses. The lessons learnt during large losses should be studied by all and to be used in the larger interests of the society. The proper design, operation and maintenance of systems and procedures will reduce the impact of losses should they occur in future. This paper discusses about some of the learning from large losses.

INTRODUCTION

Fires in various buildings located in the industrial and non industrial sectors have caused major losses. The size of the losses are determined by the number of deaths and injuries, financial losses and interruption in the business operations etc. The most severe damage had been felt by many of the fire affected organizations in terms of their reputation damage. This is felt more in the case of service sector. Despite the technology development in the various walks of life the lapses in the fire safety pose the same threat which the world has experienced few decades ago. The analysis of losses and the learning from the losses can help the organizations to plan their fire safety which includes the prevention, passive protection, active fire protection and emergency planning.

MAJOR FIRE LOSSES

As per National Crime Research Bureau, India about 6.1% of total deaths due to natural and unnatural causes were due to fire accidents in the year 2007 (Figure1). The fire victims during the period is reported to be 20772 which is increased by 8.1% from the previous year's statistics. The above fire deaths are in addition to the deaths due to explosion (669) and machine/ factory related accidents (836) some of them involved fire also. The major losses (each estimated over Rs. 5 Millions) reported by the Indian insurance companies in the year 2007 -08 indicate that 45 percentage of the claims are due to fire losses. Over Rs. 1952 Million are paid towards major fire claims. The other portfolios like marine and engineering each constitute only 50% of the total fire losses. The table-1 gives the major claims reported by the insurance companies in India. The statistics indicate the trend of fire portfolio forming the major chunk of insured losses. Given the lower penetration of insurance in India the actual fire losses both major and minor could be much higher. The fire losses have been reported both in the industrial premises and other non industrial premises like hotels, hospitals, commercial complexes, educational institutions, assembly halls etc.

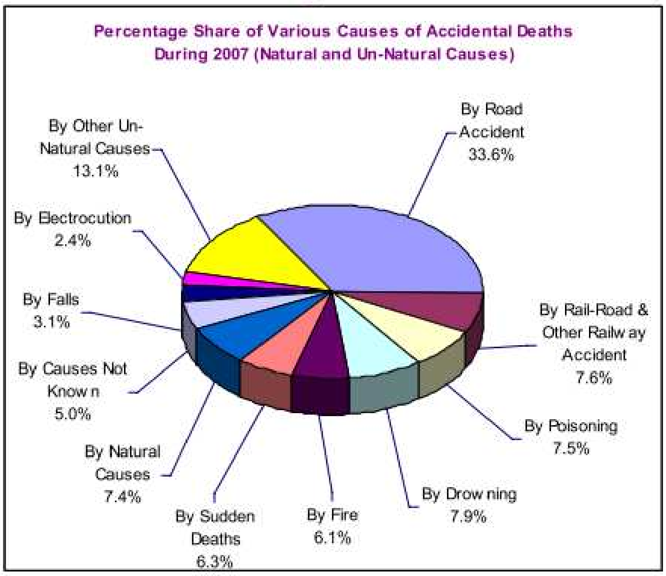

Figure1: Percentage share of accidental deaths- 2007
Source : National Crime Research Bureau, India

Table 1: Major Claims (each over Rs. 5 Million) in the year 2007-08

Portfolio	No of claims	Total loss (in INR Millions)	Loss in percentage
Fire	120	1952.5	45.41
Engineering	516	1020.3	23.72
Marine	18	1046.3	24.33
Miscellaneous	7	280.9	6.53
Liability	0	0	0
Total	661	4300.0	100

ANALYSIS OF LOSSES

In general the fires in the non industrial buildings where the assembly general public have caused more loss of human lives and the industrial fire accidents have caused more financial losses in terms of property damage and business interruption. Table 2 gives a press report on a major fire in one of the petrochemical complexes. Though causes of fire accidents are many the common features of the major fire losses include failure of systems causing release of combustible and flammable materials, presence of ignition systems, spread of fire due to poor construction/ equipment and building lay out and ineffective fire emergency response. For ease of discussion it may be stated that many of the above causes are due to the failures of the following:

- Layout of buildings,
- fire resistant structures,
- Design and maintenance of equipment and instrument
- Design, operation and maintenance of fire protection system,
- Fire safety training and emergency drill etc.

Table 2 : Press Clipping on a major fire loss
Haldia Petro may get Rs 310 cr for fire losses **BS Reporter / Mumbai August 18, 2009, 0:05 IST** Haldia Petrochemicals may get Rs 310 crore insurance claim for a fire that engulfed a part of the mother plant on July 2 this year. According to a senior insurance company executive, the plant is insured by four companies, New India Assurance, National Insurance, United India and ICICI Lombard Insurance Company. Out of Rs 310 crore, Rs 100 crore is for loss of property while the rest, Rs 210 crore, is for loss of profit. The plant is likely to suffer 30 per cent loss of capacity because of the accident, affecting the company's profitability in 2009-10. Ram Prasad, general manager, General Insurance Corporation (GIC), said the reinsurer would bear a part of the total claim but did not know the exact amount to be paid. The company could not be reached for comment. An executive of a public sector company that has insured the plant said that the exact loss because of damage to plant and machinery was not known. However, he said it could be around Rs 300 crore. The fire had destroyed a boiler within the naphtha cracker complex and caused collateral damage. However, no loss of life was reported when the furnace of the naphtha cracker unit caught fire. The plant is 125 km from Kolkata. The company said the plant caught fire due to apparent malfunctioning of some control systems. The company had posted a loss in 2008-09 after reporting profits for the last five years. It posted a loss of Rs 275 crore as compared with a profit of Rs 279 crore a year ago. Its profits were affected by the 5 per cent import duty on naphtha and the global financial turmoil.

LAYOUT

Layout of any premises deals with the location of the various buildings, roads, utilities, fire protection facilities etc. Radiant heat effects are significantly reduced by distance. Buildings made of non combustible construction materials and combustible materials are not affected unless the buildings are impinged by direct flame. Various literatures like Petroleum Rules, Factories Rules, Oil Industry Safety Directorate Standards, National Building Code, Tariff Advisory Committee standards etc provide guidelines on the spacing of buildings for various occupancies in India. Insurers evaluate the risk of occupancy based on the separation distances between the buildings. Depending on the hazards of the buildings the minimum separate distances are specified by the standards. In case the nearest buildings fall with in the specified distances the adjacent building is considered to be the part of the building in consideration. The Probable Maximum Loss values which represents the loss due to potential fire/explosion scenarios to insurer increase because of the above factor and premium values charged will increase. From the fire safety angle the fire load of the block increases considerably which requires higher passive and active fire protection levels. Fire fighters will find it difficult to reach the seat of fire to control the fire effectively. The lay out aspects should include the availability of wide asphalted/ cemented roads considering the movement of fire engines. The users of the industrial and commercial premises should be aware of the relevant standards. A list of some of the national and international standards to decide the layout of standards is given in the table 3.

Table 3: Standards for designing the layout of the premises	
BIS	National Building Code
OISD 118	Layouts for Oil and Gas Installations
API RP 14J	Recommended Practice for Design and Hazard Analysis for Offshore Production Facilities
Tariff Advisory	Building Regulations

Committee	Fire Protection Manual Petrochemical Tariff
API RP 2001	Fire Protection in Refineries
API Std 2510	Design and Construction of Liquefied Petroleum Gas (LPG) Installations
Publ 2510A	Fire Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities
AIChE Center for Chemical Process Safety1 (CCPS	Guidelines for Engineering Design for Process Safety Fundamentals of Fire and Explosion, AIChE Monograph Series, No. 10, Volume 73. Stull, Daniel R
FM Global	FM 7-44 Spacing of Facilities in Outdoor Chemical Plants
NFPA 30	Flammable and Combustible Liquids Code
NFPA 80 A	Recommended Practice for the protection of buildings from exterior fire exposures

FIRE RESISTANT STRUCTURES

Analysis of large losses indicates that the fire damages could have been controlled effectively had the structures been resistant to the fire. Inability of structures to withstand the fire till the fire protection activities reach their full potential had aggravated the situation causing both loss of lives and loss of property. The fire resistance requirements of the structures depend on the type of occupancy, fire load, nature of materials handled etc. Fire resistance rating expressed in terms of hours varies from one hour to four hours. The segregation of staircases, lift wells etc help greatly in case of dealing with large fires in multi-storeyed buildings. In case of industries fire proofing of structures in high hazard areas helps in mitigating the losses to a greater extent. The importance of fire proofing is evident in many large losses including the one that happened in Furmosa Plastics Corporation, USA during 2005.

The purpose of fire proofing is realized during the early stages of a fire when efforts are primarily directed at shutting down units, isolating fuel flow to the fire, actuating fixed suppression equipment, and setting up cooling water streams. If pipe and equipment supports are not fire proofed they lose their strength due to fire-related heat exposure leading to their collapse and cause gasket failures, line breaks, and flammable material release. In addition, if control or power wiring is incapacitated, it may become impossible to operate emergency isolation valves, vent vessels, or actuate fire-damaged automatic or manually activated water spray systems. It may be understood that Fire proofing does not extinguish fires and may have no significant effect on the final extent of property damage if intense fire exposure persists significantly longer than designed into the fire proofing system. If activated while fire- proofing is still protective, cooling from fixed or portable fire- water can extend the effective time of passive fire protection beyond its nominal fire resistance rating, provided that that force of the fire water application does not damage or dislodge the fire proofing material. The properly used fire proofing systems can help reduce losses and protect personnel and equipment by providing additional time to control or extinguish a fire before thermal effects cause equipment or support failure. Based on the envisaged fire scenarios and time of resistance required considering the existing fire fighting response the materials like dense and lightweight concrete, mastic, intumescent epoxy coatings, lightweight cementitious materials, masonry blocks and bricks can be chosen for fire proofing.

DESIGN AND MAINTENANCE OF EQUIPMENT AND INSTRUMENT

In case of industrial premises various types of mechanical equipment and machinery, electrical systems and instrumented control systems are used for the manufacturing activity. Improper functioning or failure of the above systems has caused the major fire accidents. While mechanical failures result in loss of containment or explosion related scenarios the failure of electrical systems provide the source of ignition. Due to technological development the automated instrumented systems are used in the industrial and non industrial systems. Failure of these systems not only cause the operation related issues but pose the dangerous situations for the equipment and plant concerned. When such types of automated instrumented systems are used for critical safety functions their reliability plays a crucial role. In case of manufacturing industries like process industry Safety Integrity Levels of such Safety Instrumented Systems which symbolize the reliability of levels of instrument used are crucial and are determined by the effects created by the failure of such instruments. The concept of Risk and Reliability is being adopted worldwide in case of mechanical equipment. The Risk Based Maintenance is drawn up by the facility owners based on the risk levels posed by the failure of such equipment. In case of electrical systems the preference should be given to the suitability of electrical equipment to be used in the area from the fire prevention point of view and the increased fire resistance properties to with stand the situation should the fire break out. Most of the fires in the non industrial type fires are attributed to electrical causes. The need for proper selection and maintenance of electrical systems is one of the key learning from the major losses.

DESIGN OPERATION AND MAINTENANCE OF FIRE PROTECTION SYSTEMS

Most of the fire loss incidents have indicated the inadequacy of fire protection systems available at fire affected site or inadequate preparedness to deal with such scenarios. The design of fire protection systems (fire detection and fire suppression systems) should be aligned with best available national and international standards. In India the standards brought out by Tariff Advisory Committee and Oil Industry Safety Directorate provide basic design guidelines in addition to those provided by relevant statutes. However the interpretation of these standards is crucial for any designer. The designer should have the fair knowledge of risk assessment for better use of these standards. Wherever the industry specific requirements exist the relevant industry specific standards are to be used. Standards are to be supplemented with the Risk Assessment studies. The crucial decisions of selection of fire pumps, location of fire pump house should be based on risk assessment only. While carrying out fire hazard management studies of major oil installations in abroad it was observed that the fire pump house fell with in the hazardous area. Similarly incase of fire pump houses located in the basements of multi storeyed buildings without external access these fire pump houses can not be approachable. The highest level of protection becomes unusable in case of major catastrophic situations.

In deciding the water quantity requirements the standards differ on the basic philosophy of whether two simultaneous fires are to be considered. While Indian fire protection standards brought out by Oil Industry Safety Directorate and Tariff Advisory Committee suggest the two simultaneous fire scenarios for the design of water based fire protection systems the international standards brought out by agencies like National Fire Protection Association and American Petroleum Institute are silent. Indian standards seem to be clear and conservative with respect to fire water demand calculations considering the lack of adequate infrastructure in our country.

The other crucial aspect of fire water design is the number of hydrants and monitors to be used in case of fire and hydraulic design of fire water mains. Network analysis should be done periodically of the existing fire water systems to verify whether the system will be able to deliver the required flow of water at the specified pressure at the identified outlets. Sizing of the hydrant mains decides the velocity of water flowing through the outlets which in turn is decided by the hydraulic design. In one of the refineries where a network analysis was carried out it was found that the system designed for two simultaneous fires could not deliver the requirement because of higher flow of water through the spray lines and the long range monitors. It was found that the use of non standard monitors resulted in the above situation. This also in turn affected the performance of spray and foam water system connected to the network. Above all the practice of using the fire water for process and other non fire related purposes should be discouraged. In the above quoted refinery study more than 20% highest water demand was observed to be used for other purposes. No design can meet the above fire demand if such misuse of fire water takes place.

In one of fire drills conducted in the terrace of the high rise hotel building the water flow stopped immediately after the commencement of the drill. When checked it was found that none of the pumps was kept in auto mode fearing damage to the fire pump! It is surprising that the occupancies with highly automated and sophisticated control systems are afraid of maintaining the simple fire protection system and are unable to control the fire water pilferage!

In one of the transformers of the power plant there was a major fire and contrary to the expectation the high velocity spray system provided in the transformer could not control it effectively. A detailed study revealed that the sprayer orientation and the distance of sprayer from the transformer were not as per the design suggested by the standards.

In a fire at the server room the operation of carbon di oxide flooding system could not prevent the complete damage to the location. The design and maintenance of gas suppression system for critical areas like server room etc should be in line with the standards. As frequent performance testing is not possible the monitoring of parameters like the pressure and weight of gas cylinders should be given due importance.

FIRE SAFETY TRAINING AND EMERGENCY DRILL

Lack of knowledge in the area of fire safety and inadequate emergency drills delay the fire fighting operations. For example the fire design assumes use of four hydrants and one monitor as supplementary hose streams for fire water demand calculations and the reduced amount of water spray quantity for the tanks located with in 30 meters from the edge of the tank envisaged to be on fire. In real scenario if the water spray system is turned on for tanks which are even 30 m away and more number of hydrants and monitors are operated the system will not be able to deliver required water at required pressure. Most of the times the fire fighters keep complaining about the design because of lack of this basic knowledge. On the other end the standards like OISD assume 3 liters per minute per square meter for the shell protection of tank on fire and only 1 liter per minute per square meter for the adjacent tanks. However the spray system is designed to provide the 3 litres per minute per square meter rate of water for all tanks as it may not be known which tank will be on fire. It is also worthwhile to consider the argument how a flow to the spray system of adjacent tanks can be controlled as envisaged by the standards like OISD in case of fire emergency. In nutshell the fire fighting is hampered due to rapid consumption of water and inadequate pressure due to wrong use of fire fighting systems.

Periodic mock drills help to identify the lacunae in the existing systems. In one fire mock drill conducted in a power plant at Gujarat the shift manager who was the emergency authority in shift could reach the fire affected site after 20 minutes because of lack of transportation! In another case fire fighters of in house fire station reached the site which is just one km away from fire station after 15 minutes. It is because of the fact that the fire drill was conducted during shift change over time and fire crew had gone to gate to change their duties with their relievers!

Adequate fire safety training and periodic emergency drills will identify all micro level issues and solutions to make the emergency response more effective.

CONCLUSION

Losses teach us lot of lessons in addition to the damages. Unfortunately this only gain from losses is not used effectively by those affected by fire. It is also not necessary for every one to learn in the hard way. The lessons learnt during large losses should be studied by all and to be used in the larger interests of the society. The proper design, operation and maintenance of systems and procedures will reduce the impact of losses should they occur in future.

REFERENCES

1. National Crime Research Bureau, Accidental Deaths 2007 Report
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3. Oil Industry Safety Directorate standards
4. American Petroleum Institute standards
5. National Fire Protection Association standards