Industrial Explosion Protection

G. J. GRABOWSKI, Fenwal Inc., Ashland, Massachusetts

AT THE INTRODUCTION of a new product or system the first question that comes to mind is, "do we need another safety gadget?" With regard to industrial explosion protection systems this is easily answered since the explosion loss figures for industry in general indicate a definite need for a protection system of this type. Recently an insurance company quoted a figure that explains very briefly how great this need actually is: "out of every $4 paid in losses by insurance companies, the portion represented by losses from explosions was equal to $1 or 25%." This figure is certainly astounding and makes one wonder why there have been no more effective forms of protection available to assist in reducing this loss. It has been necessary to depend entirely upon prevention techniques to keep a catastrophic explosion from occurring in various industrial plants and processes. While explosion-prevention techniques have improved immensely over the past few years through the activities of safety committees and various protection agencies, the loss figures still indicate that explosion prevention is not enough and there is a definite need for a protection system. It is impossible to eliminate the human element and malfunction of equipment in the operation of plants, and it becomes necessary to rely on a protection system to back up the prevention techniques that are used.

It has been estimated from the records of industrial explosion losses that the total for vapor explosions is approximately $22,000,000 annually. Undoubtedly a protection system would greatly reduce this figure and would increase the safety of many types of processes and eliminate large property damage and loss of life.

The question is generally asked, "why are these losses as high as they actually are?" This can easily be answered since production of various chemicals and other related products is rapidly becoming automated and the operation of large plants is being placed in the hands of instruments and controls. We are continually trying to increase our productivity with the end-result of increasing profit. Accompanying this is the problem of reliability in instruments and the necessity for added protection to prevent possible damages that may result from faulty operation of this equipment. It can safely be said that during the next decade or so the explosion hazard problem in industry will certainly not decrease but instead will greatly increase through further use of automated processes.

This new field of industrial explosion protection is centered around one factor, speed. Every component in the system must act as rapidly as possible to combat the hazard that has been detected. This speed has been incorporated into a large number of devices and, in turn, has opened up entirely new applications to many other types of hazards in industry. In the coming years a greater need for speed of operation of protection systems will be encountered, and this new field will meet the demands that will be placed upon it.

WHAT IS explosion protection? This system was developed primarily for the protection of aircraft fuel tanks, the need for which was indicated by the losses that had occurred during World War II from exploding fuel tanks in combat airplanes. The system was originally developed in England, and since that time its use in aircraft has grown until it has now become accepted as one of the standard means of protection. However it is felt that the major benefit will be the reduction of property damage loss and loss of life that have occurred from industrial explosion hazards. As I have already pointed out, the need for such protection is definitely indicated by the losses that have occurred, and it was the Graviner Manufacturing Company Ltd. of England that pioneered the development of a system applicable to the industrial type of hazards. This company has been prominent in the application of this system in England; and by association my company has been actively engaged in similar projects throughout the United States. This field has broadened considerably since its inception and now encompasses flash-fire protection and protection against special hazards that are encountered in the manufacture of explosives, rocket fuel propellants, etc.

When these new systems are described to people who are associated with explosions, the general reaction is that such a system is impossible in view of the very fast operation time that would be necessary to combat an explosion. Up to a few years ago explosions were considered to be instantaneous, and it was only by virtue of thorough investigation that the fact came out that a period of time was available during the incipient stages of an explosion to operate a rapid extinguishing system. To illustrate the time that is available at the beginning of an explosion, a typical explosion pressure curve for a hexane-air mixture is shown in Figure 1. It can be seen that the explosion has a constantly increasing rate of pressure rise and that during the incipient stages the slope of the curve is relatively shallow. It is during this initial period of time while the explosion is building up to 1 p.s.i. that a system can be operated to extinguish the flame front and reduce the explosion pressure. Figure 2 illustrates what actually occurs when the explosion is suppressed. It can be seen that the explosion pressure is stopped before it reaches a pressure of 3 p.s.i.

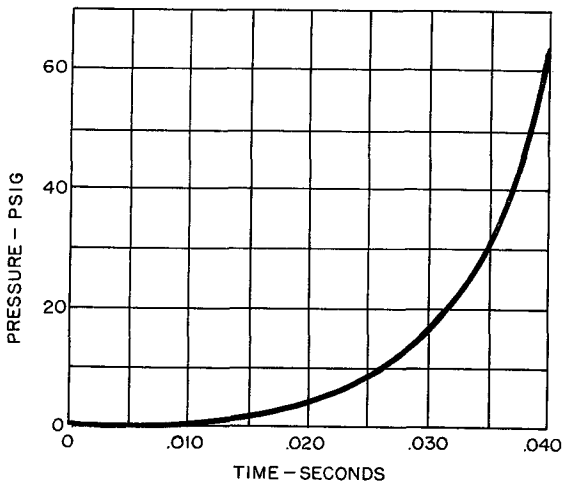

FIG. 1. Typical explosion curve hexane-air mixture.

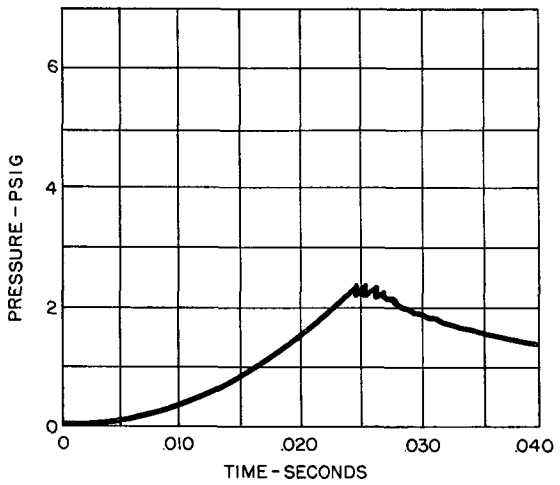

FIG. 2. Typical suppressed explosion hexane-air mixture.

The question is asked, "how does the system operate?" Figure 3 shows the basic operation of a suppression system. The detector senses the incipient explosion either from the rate of pressure rise that accompanies the start of the explosion or from the radiation increase from the flame front. A signal is then sent to the suppressor, which is burst open by an explosive charge; a very fine spray of liquid is discharged into the volume which suppresses the flame front of the explosion. The suppressing action is accomplished by a rapid cooling through vaporization and the inerting of the vapor space.

From this basic system a number of other systems have been developed to combat the many variables that exist in processes throughout the United States. These have placed different requirements upon a protection system of this type and make it necessary to incorporate other features to provide adequate protection. These system variations are shown in Figure 4 and are primarily used either to relieve the explosion pressure or to isolate the explosion flame front from other portions of the plant. In the method that is used the vent is explosively operated; it is possible by this means to have a completely open vent within a period of 2 milliseconds from the detection of the

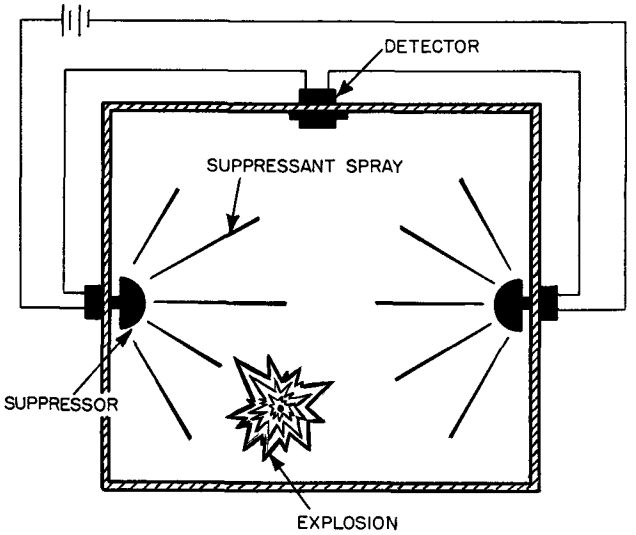

FIG. 3. Operation of a suppression system.

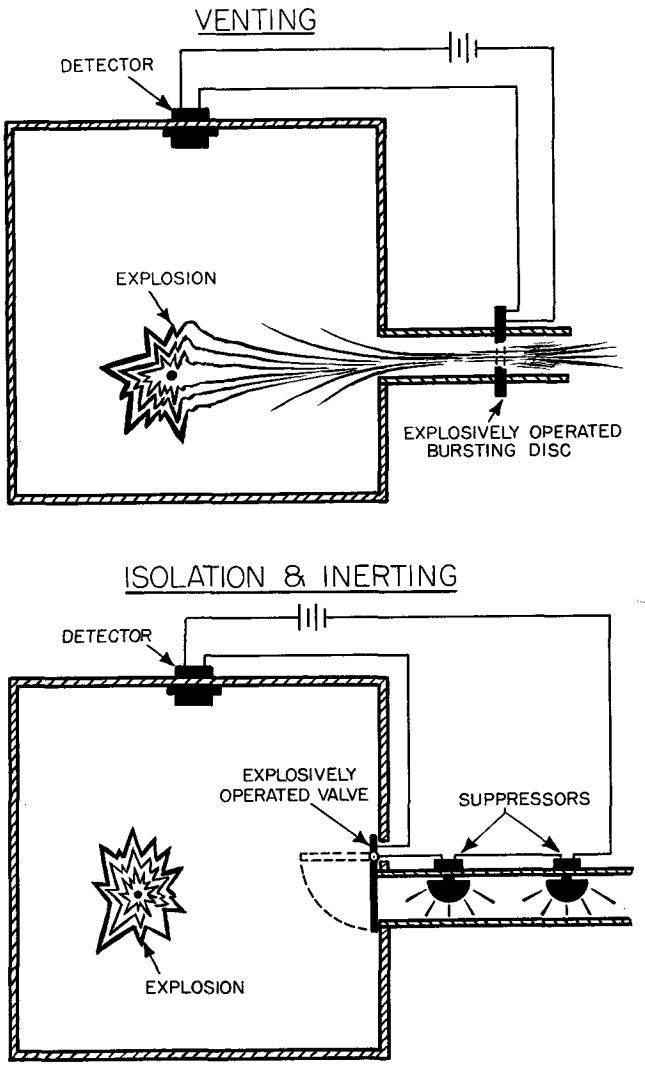

FIG. 4. Explosion protection techniques.

explosion. In isolating the explosion from other sections of the plant it is possible, through the rapid closing of valves or by inerting other portions of the plant, to prevent the spread of the flame front. It should be noted that all of these devices are operated by explosive means to combat the hazards of an explosion. To some people this means that we combat an explosion with an explosion; it is very possible that this description accurately describes the basic method in all of these systems.

In the majority of applications it is necessary to incorporate several of these systems to obtain complete protection. In many of these installations the system is also called upon to combat fires that may occur, and it is possible to do so by using the same equipment that has been applied for the explosion protection. These installations have been the first of an automatic explosion-and-fire protection system throughout the entire world.

It is generally asked how this protection can be applied to various processes. Yet in many instances personnel associated with industries where extreme explosion hazards exist are not even interested in hearing the answer. These people comment that their plant and processes already have an excess number of safety devices and another gadget is not needed. I

have had the opportunity to tour several of these plants; while extreme care is taken in the application of fire-protection systems, very little consideration is given to any type of explosion protection. One of these plants recently had a half-million-dollar explosion; yet the first reaction of safety personnel was that the system would probably be too expensive to install in any of their processes. It is difficult to see, with the evidence that is available regarding explosion losses, why safety personnel and manufacturing personnel continue to disregard the need for advancement in the fire-protection field. Fire-protection systems are being installed on hazards where they are totally inadequate to cope with the speed of the fire or the explosion that might occur.

By the application of these industrial explosion protection systems it is easy to see that the following benefits can be derived, all of which will result in increased profitability:

a) a reduction in the annual explosion property losses;

b) a reduction in the loss of life that may occur from explosions;

c) a decrease in the cost of construction where it has been normal to have sufficient structural strength to withstand the internal pressure that would develop from an explosion;

d) elimination of the possibility of interrupted production and a consequent loss of sales;

e) a possible use of more hazardous materials in processes which would result in increased productivity. A number of these materials are generally not considered on account of their hazardous nature and the lack of a protection system.

Industry in general should realize that advancements in safety systems must keep up with the advancements in the various production methods throughout the United States. Only by keeping up will it be possible to stop the increases in the losses that occur annually. We must reach a point where these figures begin to decrease despite an increase in the over-all production index of the country. Continued efforts must be made for bettering the protection against property damage and loss of life, and industry should recognize the benefits from the effort.

Inflation in the Claim Business

PAUL L. HOFFMAN, Hartford Accident and Indemnity Company, Chicago, Illinois

LET US DISCUSS inflation in the claim business and what you can do about it. I work for a casualty insurance company, supervising Workmen's Compensation claims, alongside others who supervise other types of claims. The inflation lies in the cost of the claims. The number and severity of accidents did not increase from 1956 to 1957, and the rate of accidents per 100,000 persons was lower than it has been. But the cost of these accidents is inflated. Of course, medical costs are up, as is wage loss. As everybody knows, the dollar has been deflated and the number of dollars for such intangible losses as pain and suffering increases. Newspapers, radio, and television are full of million-dollar figures nowadays. Newspapers publicize jumbo verdicts. From October 1 to October 11 one Chicago newspaper told of settlements of $45,000 and $37,500 and verdicts of $76,000, $100,000, and $147,000. Publication of a jumbo verdict increases settlement values of all claims in the area.

And sometimes it seems that public attitudes have changed. We can remember when people were not claim-conscious. When one got hurt, he returned to work as soon as the doctor told him to; that was the thing to do. Now our industrial doctors tell us that the first thing they are often asked by an injured workman is, "how much is it worth?"

In automobile accidents many are out for all they can get, regardless of fault or negligence; judges won't take cases away from juries; juries seem little interested in defenses of no negligence. In hospital insurance some people stay as long as their benefits extend; some even have more than one policy. The insurance industry started out to provide indemnity for expenses; it looks as if some buy for a profit.

Some 5,000 attorneys who usually represent claimants have banded themselves together in a National Association of Claimants Compensation Attorneys. They promote every method they can think of to increase the size of jury verdicts and the awards of commissions. They publish a journal; they promote education sessions; and they tirelessly educate their members to get what they call "the adequate award." Of course, what was the adequate award yesterday must be exceeded tomorrow.

NOW WHAT can you do about this? The first way to reduce claim costs is not to have accidents. In that regard let me first, as a claim man, pay my compliments to the personnel people and safety men. A personnel director can be of great help by hiring healthy, well-adjusted, stable people, chosen to fit their jobs, by inculcating company loyalty and cooperation, and by continued good personnel practices.

Equally important are a good, intelligent safety program implemented enthusiastically by all in the company from the executive level down, the maintenance of high safety standards, and the best safety equipment. A great difference can be achieved in accident frequency and the severity rates by intelligent management.

The second way to reduce costs is to keep the cost of each accident down. The first thing to do is to get the experts in. Whether you are self-insured or protected by an insurance company, all accidents must be reported immediately to those who specialize in handling accidents. Two words are mandatory, "all" and "immediate." Let no one, from the foreman to the superintendent, attempt to decide whether to report or not to report, or when. And "immediate" is when the accident happens, not hours or days later.

You should provide immediate medical first-aid treatment by, whenever possible, a doctor who will keep records. Then immediate, complete investigation is fundamental and necessary. It should be started at once, before the dust falls, even before an insurance investigator is able to arrive. Keep the idly curious away. Preserve the condition as much as possible. Take pictures if possible. Write down whatever is said by those injured and those immediately around or first coming there.