FIRE PREVENTION AND PREPAREDNESS IN HIGH RISE BUILDINGS AND PLACES OF PUBLIC ASSEMBLY

by Mr. Brian Collins, Chairman of the Fire Prevention Technical Committee, Chief Fire Officers Association, United Kingdom

Homo sapiens are not well equipped to withstand a great variety of climatic conditions to which we are subjected on this planet. Shelter, in the form of buildings, is how humanity has responded to external conditions. It has required the use of intelligence and adaptability to enable mankind to meet this need for shelter.

The buildings we produce are diverse products of invention and cultural tradition to keep the elements firmly outside but, at the same time, keeping human beings inside. This restriction requires special arrangements to enable him to live safely and, when he desires, to get out safely.

As constructions become more substantial and complex to meet the increasing technological needs of man, so the corresponding problems increase. Furnishings were at first simple and possessions were few in number, mainly restricted to absolute necessities. Greater affluence progressively increased the quantity of these items with the worlds regional variations becoming less distinctive.

High rise, or multi-storey buildings and complexes, housing areas of multiple assembly are the ultimate development in this respect at the present time and those of you who attended "Fire International '84" at Birmingham, England, will have heard a great deal concerning the requirements for safety in the design and control of buildings and the varying attitudes to the problems of to-day, including a very interesting paper by the Director of Fire Service in Singapore, where 75% of the population, more than 1.8 million people, are now housed in high rise apartments.

The job of the Fire Service Officer is to understand the problems that high density, high rise structures create; how society is changing its requirements and preferences and then attempt to solve the resulting problems, and at the same time, maintain the kind of environment that is likely to be regarded with favour in future years. This means that in looking ahead one is trying to predict the future and, as a result there is a high possibility of error. However, the best that we can do is to analyse the current conditions and features and to use this experience to predict trends as logically as we can. It is important that we are not only responsible to change but use our specialist knowledge to create change for the better, and in our case for the safer living and working conditions.

And so, what are we trying to achieve ? The Fire Service Officer, the Architect who designs the building, the client for whom the structure is being produced, and the whole team who will be involved with its construction. Everyone is working, or at least should be working, to the same objective - a building which is functional, a pleasure to live or work in and one which is safe. In theory, this should be quite a simple matter and providing initial considerations involve all aspects and all

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interests who are likely to be concerned with the design at a very early stage, then fire safety matters become an integral part of the concept and their provision is a straightforward matter. It is important therefore that the individual problems created by location, use, construction or the environment are fully understood from the outset and this becomes the first objective, one of education.

Let us start by defining a high building. In over simplified terms this can be considered to be any structure which has upper floors which are beyond the reach of normal mobile fire fighting equipment which is available in the local area in which the building is to be erected. The building may house hundreds, or even thousands, of people at the same time and it may incorporate shops, stores, areas of entertainment, offices and other places of employment and living accommodation. It can be immediately seen that within a comparatively limited space a whole range of distinct fire hazards may be incorporated within a single building. If you add to this the multiplicity of dangers and the psychological difficulties that vertical development creates, it can be readily seen that a sudden and dramatic change in the normal, that is by the occurrence of something unusual, such as a fire, can quickly create a crisis situation.

The most obvious reaction is to get away from the building. But on the basis of sheer physical effort, escape via staircases from any building higher than twenty storeys, no matter how well designed from the fire escape point of view, is hardly practicable and a different approach to ensure personal safety has to be incorporated into the basic design. This must also take into account fire fighting operations which have to be commenced whilst some of the occupants of the building remain within the structure. Hence, there must be areas of safety to which occupants can go quickly.

What then are the general considerations associated with high buildings that we need to incorporate into our education programme so that designer, constructor and user can appreciate the problems that may beset them ?

a) Access for fire fighters.
b) Means of escape from fire.
c) Restriction of fire spread.
d) Fire warning systems and public control.
e) Means of calling the Fire Brigade.
f) First aid fire fighting equipment and water supplies.
g) Control of smoke and heat.

First, let us consider access to the building. In the event of a fire situation arising within the structure, it is essential that suitable provision is made for access for fire fighters into the building for the purposes of not only fire fighting but rescue, with facilities to enable the Fire Brigade to deal with a fire on any floor of the building as quickly as possible. The aspects of fire fighting will be covered in more detail when Mr. Duncan McCallum presents his paper tomorrow.

Also, under the heading of access to the building is the overall consideration for Fire Brigade appliances to reach the outside of the building to deploy its pumps, ladders and rescue equipment. This is a point that is difficult to envisage when the prime concern of the users of the building is to approach and park as closely to the point of access, which is available to them under normal conditions, as possible.

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Means of escape - the principles governing means of escape from high buildings are no different to those which relate to other buildings but because the possibility of external rescue from upper floors may be remote, then the internal arrangements must be absolutely reliable. It will now be apparent that the staircases are providing the only safe access for fire fighting personnel, which will become more important as the fire develops but that also this same staircase must maintain its integrity if the occupants are to effectively leave the building by self-rescue. I do not propose to elaborate on rescue and evacuation techniques since this will be a specific discussion topic dealt with later this afternoon.

Let me say that a basic concept in fire prevention thinking in the United Kingdom is that means of escape from all floors should be such that every occupant can leave safely by their own unaided effort. This requires compartmentation of the stair by its enclosure throughout its height with fire resisting construction, the standard of fire resistance being adequate for the related risk area through which the staircase passes. It is essential that there should also be efficient means whereby heat and smoke is prevented from entering the staircase protection lobby, accepting that there is a possibility of percolation of small amounts of smoke into the staircase enclosure due to its use. The problems of ventilation of the stair wells must be clearly understood and, although it is often possible to provide ventilation by means of openable windows, or other direct access to open air, it must not be forgotten that in many multi-storey buildings the floors extend below, as well as above, ground floor level and where air conditioning is an integral part of the building, openable windows would not be an available feature. In this instance specialist smoke extraction or pressurization of the staircase is required.

It must also be acknowledged that the provision of permanent openings has never been favoured by occupants since it leads to draughts and rain and dust penetration. Their effectiveness as a means of clearing smoke has also been called into question and with certain notable exceptions, few full scale tests have been performed to determine the effectiveness of permanent openings in external walls as a means of clearing smoke and the test programmes that were undertaken drew the conclusion, in part, that the role played by weather conditions in affecting the air-flow pattern was so critical that the effectiveness of permanent openings as a means of evacuating smoke is not predictable and could not be relied upon with any degree of certainty, unless the openings were so arranged as to produce continuous through draughts.

The whole spectrum of movement of smoke on escape routes is a fascinating subject. The need for positive smoke control that is readily available whenever a fire starts, which is reliable and capable of functioning for a period corresponding to the standard of fire resistance of the elements of structure of the building and yet which is at the same time simple and economic, could undoubtedly form the basis for a further discussion topic at some time in the future.

Let me assume that we have educated the specialists and the general public alike to the needs for access and adequate means of escape; there still remains the problem of controlling fire spread within the building by the provision of individual compartmentation. The fire stopping at

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structural junctions, the protection of open shafts and ducts, the fire stopping of services where they pass through holes in the main structure, the correct fitting of doors and surrounds, the provision of effective shutters to protect later openings, and the correct treatment of suspended ceiling spaces, to mention but a few of the points that require consideration.

In a similar manner, fire spread between buildings requires attention because of the possibility of air-borne debris falling onto, or into, nearby buildings; convected currents of hot gases affecting buildings in close proximity and thermal radiation across open spaces, courtyards or wells. Some of the films taken at serious fires in recent years provide an interesting view of the movement of vapours, gases and smoke.

After considering the provisions to prevent fire spread, we must now move on to raising the alarm in the event of a fire occurring and here the emphasis must be on a system which is easy to operate and which provides an effective warning, audible throughout the building, loud enough to alert sleeping occupants, if that is the type of occupancy, and which will not expose the person giving the alarm to any undue risk.

There are many methods by which an alarm of fire can be given from manually operated sounders to manually operated electrical systems, automatic electric systems and, in some cases where an audible type of alarm system would not be completely satisfactory, such as in places where deaf or partially deaf people may resort, where it would be necessary to add a visual indication.

Having sounded or otherwise raised the alarm within the building, it is of utmost importance that the alarm should be relayed to the local Fire Brigade by a reliable method which should function at all hours of the day and night, and every day of the year. Whilst this is frequently by the simple means of an exchange telephone, it could equally be by some more sophisticated automatic detecting system which is either directly connected to the Fire Brigade or to some alternative collector terminal points, such as a Central Alarm Station. The main philosophy behind the design and provision of such an alarm is to avoid any delay in summoning the aid of the Fire Brigade.

We now come to the provision of aids to fire fighting, either in the form of hand fire extinguishers or hydraulic hosereels provided in sufficient numbers to give adequate cover to the premises. Whilst every effort should be made to provide a fire fighting means of one pattern to ensure a uniform method of operation and ease of maintenance, none-the-less special risks will of course require extinguishers of a type suitable for that risk.

All of this raises the need for training and fire drills. Whilst the form that the drill should take will depend largely on the type of premises, the drill should involve both staff and occupants and the frequency with which the fire drills are held will depend largely on the age and general intelligence of the occupants and on the rate at which the occupants change. In those premises where the occupancy change is

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comparatively low and the occupants are capable of grasping instruction in a normal way, the frequency of drill will be much lower than where there is repeated changeover or the age and general intelligence present special problems. I am deliberately using the word "training" as a complementary subject to the education to which I referred earlier. Often the two words are used in the same context but it would be misleading to assume that the terms are identical and perhaps it is appropriate for me to clarify the essential differences.

The purpose of educating people to understand fire is to enable them as individuals to develop value judgements, logical thought and imagination of the possibilities that occur in the complex structural constructions that we are considering today. By contrast, the purpose of training is to produce a response in the individual to a set of circumstances that have arisen due to the unusual and sudden occurrence of fire or other disaster which he is not used to in his normal environment. The most important question is whether the occupants are sufficiently aware of the impact of fire on their current activities and do they know the steps which must be taken in an emergency situation if they, and others for whom they are responsible, are to survive uninjured.

The emphasis in this paper has been on the understanding and response of the individual to an unnatural situation and the ready acceptance of the need for structural provision and a trained response under abnormal conditions. Regrettably, this approach does not always achieve the desired response and on these occasions it is necessary to revert to legislative requirement.

The subject of legislation and fire codes seems to have been a major topic in the United Kingdom for more than twenty years of my service. There seems to have been more interest in it and more activity as the years have progressed and during that period the law relating to fire precautions has become over elaborate, complicated and to a large extent not understood by the general public. The reason is more obvious when you consider that the whole science of securing the safety of the public in the face of the risk from fire is by its nature also complex and elaborate. The wide variety of building types, occupancy characteristics, materials used in different environmental situations, and the very nature and behaviour of fire itself, involves complex principles without even taking into consideration the psychological effects on people involved in a disastrous situation. Laws of various kinds relating to safety from fire have existed in the United Kingdom for at least two hundred years and, unfortunately, often originated from some disaster involving loss of life which then provided the reason for imposing the legal sanctions. The cause of the disaster was either ignorance or negligence in making correct provision for the safety of the occupants and the need for legislation was the response of the general public.

Since the legislation as it was enacted related specifically to the class of occupancy in which the disasters had occurred, e.g. factories, there became a confused pattern of legislation and it was not until the Fire Precautions Act of 1971 that an all-embracing Act was produced to remedy this unsatisfactory situation. It was drafted in a radically

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different way from any of its predecessors, enabling requirements to be imposed not just in certain limited areas of occupancy but on every kind of public building, other than those already covered by the legal requirements under the Factories Act 1961 and the Offices, Shops and Railway Premises Act or a place of public worship.

As I have just said, at the time this was seen as an all-embracing Act, although to-day it is clear that anomalies can result due to the wide range of hazards and working conditions of a vastly different nature applying to the wide array of public buildings. This way of thinking has now been overtaken by proposals which are currently under consideration to re-write the Act on the basis of self-compliance with the advice being encapsulated in Codes of Practice.

The current increasing interest in these Codes indicates a change in attitude of mind which is becoming more prevalent in the United Kingdom Fire Service and is changing the direction of future fire prevention measures.

The idea of a Code of Practice is based on advising the user of remedies to specific difficulties of whatever business or enterprise or organizations they are running and providing the information of desirable features for the building to achieve a safe environment.

There is obvious disadvantages to Codes of Practice because they remove individual prerogative, and in providing a uniform answer to a problem can in so doing provide an incorrect answer to a specific set of circumstances. A further disadvantage is that they are frequently written in very vague terminology and it is claimed, in some areas, that in this way they succeed in saying nothing at all. The last disadvantage that I shall mention is that these Codes are notorious for taking an inordinately long time to prepare.

In spite of these disadvantages, a Code of Practice is an instrument of advice and guidance that is an attempt to capitalize on the advisory functions that have traditionally been carried out by Fire Brigades within the United Kingdom and is a useful means of persuading others to do what we are advising. Used correctly they should provide a good working basis upon which to operate.

INTERVENTION OF THE FIRE BRIGADE IN HIGH RISE BUILDINGS

by Mr. Duncan Mc Callum, Technical Secretary of the Chief Fire Officers Association, United Kingdom

The need for modern civilisation to maximise space in areas of high population has led, through the use of innovation building techniques, to the development of high rise buildings in most parts of the world today.

High Rise Buildings, for the purposes of our discussion, are buildings of a height that exceeds the reach of Fire Brigade equipment. They depend for their safety on modern principles of construction, incorporating fire protection, fire fighting equipment and means of escape. In practical terms they will be any building exceeding 8 floors in height. These buildings present unique problems to firefighters in their constant battle against fire. They require both strategical and tactical planning of the highest order.

The technical press of the Fire Service and its associated literature have discussed the problems as well as the strategy and tactics many times. Firefighters know, however, that it requires a constant reconsideration and review process involving the practical exercising of these plans to ensure their efficiency. I must stress the importance of this planning, as without it rescue and firefighting will be ineffective, chaotic, engender panic and result in disaster.

The firefighting plan, although applying to all personnel in attendance at the incident, is really an aide-memoire to the Commander, ensuring that resources are deployed to the best possible advantage and that no important aspects are overlooked. The Fire Commander must bear in mind the time it will take for an instruction which will be issued at ground level, to be executed on the floor involved in the incident. Even with the use of firemen's lifts, it takes time for personnel to get themselves and their equipment to the scene. This time will be considerably extended if lifts are not available and personnel have to use the protected staircases.

The Fire Officer must ascertain the location and extent of the fire. To do this he requires information. In order to get this information, he must contact some responsible member of the building's staff. He may have to gain information from members of the public, or by visual indications. This presents the first difficulty, as people may be unaware of the incident taking place above them, or they may be moving in great haste. In either case they may be reluctant to repond to instructions.

Firemen's control panels are normally situated within each fire lift lobby at ground floor level. From this panel it is possible to have complete control of all essential and mechanical installations in the building, that is : fire switch to call lifts to the ground floor, mechanical ventilation control switches, fire alarm indication and evacuation, fire telephones. The incident Commander will normally establish his initial ground control at this panel.

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The question of evacuation becomes a real problem. If evacuation is necessary, should it be total or partial ? Experience has generally shown that it is extremely difficult and sometimes impossible to attempt total evacuation of a high rise building in an emergency. Diverting fire-fighting resources to provide the assistance needed, will certainly result in a lack of these resources to limit the fire spread. It makes better sense to control the spread of fire, thereby allowing people to move to a place of safety, and in consequence reduce the potential casualties which might otherwise occur. Persons trapped on the floor of the fire, or those above, require assistance. For the reasons mentioned, with evacuation it may be more effective to contain the fire, but equally it is essential to calm the fears of persons who may be cut off from normal exit routes, in order to avoid panic.

The next stage of the plan must be for the Fire Officer to decide his priorities, deploy his men, for rescues if necessary, and to attack the fire. To do this, he must :

a. Ensure that a fireman takes charge of the fire lift by operating the fireman's switch. The man detailed for this duty must remain with the lift at all times. Sadly there have been many fatalities when lifts, operating on the automatic recall system, have stopped at the floor involved. As the doors open, the occupants are overcome by the fire entering the lift. Lifts, however, are the only practical option of moving men and equipment swiftly to upper floors. Without these lifts buildings of this height would be unable to function. It is critical, however, that firemen only use those lifts with facilities specially provided for them, e.g. separate power supplies, communication, fireman's switch, etc. Care should be taken to ensure that these facilities are working properly before firemen commit themselves to their use. The protected staircase with its landing access through fire resistant doors should be regarded as the only safe access until firemen are sure that the lifts are properly under their control, and even then only those lifts that are provided with a fireman's switch. As has been previously stated, the construction of all the parts of the lobby are to be made of non-combustible material. There is a lobby for every 930 square metres of the occupied space. Where more than one is required, they must be arranged so as not to exceed more than 61 metres apart. This is to keep hose lines to a minimum, which assists in fire-fighting and prevents water damage.

b. The Fire Officer must ensure that dry rising mains are charged if necessary, or ensure that wet rising mains or downcomers are functioning properly.

c. Establish a forward control with men in breathing apparatus, either one or two floors below the incident according to the occupancy, and thence by means of the protected staircase to the floor of the fire. The question of this control being one or two floors below the fire, is for local determination according to occupancy. If the building is largely residential, it may be suitable to operate the control from the floor immediately below the fire, but if the "fire loading" on the floor is high, e.g. in commercial storage, it may be necessary to operate from two floors below, as there may be a danger of fire spreading to involve the floor immediately below it.

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It is a popularly mistaken idea that high rise buildings will not burn because they are largely made of concrete and steel. When the building is occupied, however, the furnishing or goods in storage may be very combustible and therefore alter the character of the building. The firemen detailed for this forward control must take with them predetermined fire equipment. This equipment should contain : breathing apparatus control equipment, 2 X 25 m lengths of flaked 45 mm hose, 1 hand controlled branch, communication equipment, large axe or crowbar, 1 X 30 m line.

If the premises are known to have poor maintenance standards or are subject to vandalism, it may be necessary to include a spanner in lieu of absent landing valve wheels. If the circumstances require other specialist equipment, it shoudl be included also, but it should be borne in mind that there is a limit to the amount which these first strike men can carry and operate efficiently. Once the initial attack on the fire has commenced, the Fire Officer must further assess the problem and decide whether he has sufficient resources in the form of men and equipment to meet his needs. To do this he must have further information such as :

a. Is the fire spreading or is it being contained ?

b. If it is being contained, is it by structural compartmentation, sprinkler installations, or by the efforts of the firefighters ? Perhaps it is a combination of all three.

c. Is evacuation proceeding satisfactorily or are additional problems being experienced ? Some of these, for example, might be the presence of disabled or handicapped persons in the building. In some large buildings a two stage fire alarm system is fitted. That is a system where on the operation of a trigger device an intermittent signal is sounded, except on the floor of origin, where it will be continuous. The floor of origin of the call evacuates while the others are on standby. To instigate further evacuation, the floor fire marshall contacts the fire alarm panel controller using a special fire telephone. If there is a fire, and following evacuation of the occupants, the Fire Brigade can take over this telephone and use it as a communication system, as there may be many radio blind spots in steel framed buildings.

Because it is realised that high buildings can present problems on means of escape and the natural concern of the people who work or live above the ground floor, an early warning in case of fire would be an advantage, therefore a smoke detector system should be installed. Smoke detectors are efficient, sometimes too efficient. They are not only effective for smoke, but dust as well. False alarms can be frequent, and as they are linked into the fire alarm, occupants become complacent when the fire alarm operates.

d. If rescues are taking place, are they making progress and are enough resources committed to the task ? Much has been said about the use of helicopters for rescue purposes, but unless there has been a purpose built heli-pad constructed on top of the building, they should only be regarded as a last resort. They are subject to immense problems such as downdraft from the aircraft, danger to it from heatrise, flame and smoke. Roofs may not be sufficiently strong enough or large enough for landing. Obstructions such as aerials, water tanks, lift motor rooms, etc. will restrict operations.

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e. Air Conditioned Systems.- Modern high rise buildings frequently use air conditioning systems to control the atmosphere within. Unless they can be controlled and switched off if necessary, they can assist the spread of smoke and fire throughout the building. Worse still, they can spread panic amongst people waiting to be evacuated, by transmitting smoke to unaffected parts of the building.

f. Electrical systems within high rise buildings are highly complicated. They are designed to carry considerable quantities of electrical power, as the whole concept of modern buildings is to make maximum use of new technology. While the hazard from electricity is the same as for normal fires, the long runs of cables through ducting, both horizontally and vertically, presents problems to the firefighter.

g. Fire Eighting Mains : in the United Kingdom a dry rising main is required in all buildings in excess of 18 metres in height. It is a tube which has a Fire Brigade inlet at ground floor, and outlets on every floor. When there is a fire, the Fire Brigade will charge the riser with water and pressurise it using the pump on the fire engine. The firemen will then go to the floor below the fire, using the fireman's lift. They connect hose to the dry rising main outlet, run the hose to the floor of the fire and put it out. So that the outlets cannot be opened, with a consequential flood, they are sealed shut with a strap and padlock. If the building is in excess of 61 metres, a wet rising main is required to be installed. This consists of a tank at ground floor, two pumps, one of which will be on standby. The pumps have to have two separate motive forces such as electricity and standby diesel. It is permitted to have two electric pumps if a separate standby generator is provided. In a similar manner to the dry rising main, there are outlets for Fire Brigade connection on each floor, except that the main is charged with water at all times. To prevent water damage when adjusting the flows and pressures, a separate overflow pipe is provided.

The Fire Officer must also bear in mind that wind strength increases and varies considerably in direction, the higher the floor level. This will have a considerable effect on evacuation, rescue and firefighting operations. There are many difficulties and dangers in any large scale high rise incident. Too many to mention in detail, as they will vary according to the circumstance and indeed are present in varying forms at most large fire incidents. While the provision of built-in fire protection equipment such as fire lifts, protected stairways, sprinkler installations, dry or wet fire water mains, will assist the fireman, the fact that the fire can usually only be tackled from below with the possibility of firespread away from the fireman and onto higher floors, makes a very difficult task.

Communication is important at any fire, but especially so at high rise incidents. Normally firemen can observe the spread of fire and the results of their action to contain it, but at these incidents it is impossible to observe all the developing fronts. Special fire telephones may be installed along with the firefighting mains, and these are the most desirable as they connect with the fireman's control panel at the entrance. In the absence of these, walkie-talkies or personal radios should be provided, but they should be well tested to ensure that transmission blind spots are not created by shielding in steel framed buildings.

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The needs to be a sufficient breathing apparatus capability. The absence of natural ventilation and the effects of smoke travel within a "tight" air conditioned building, can produce unexpected problems for the firefighter. He may be suddenly cut off by smoke. The similarity of corridors in such buildings makes orientation difficult, and there is always the increasing possibility of a flashover the longer the incident continues. The sealed nature of these buildings often result in smouldering fires, which create considerable quantities of heat and smoke. All this heat is at first contained within the building, making the fireman's task more arduous.

Large chards of glass flying from high buildings present a serious hazard, not only to firefighters below but also to members of the public. Although such onlookers may be kept well back from the incident, large fragments of glass may "float" considerable distances on thermal currents with lethal consequences. The fireman must also bear in mind the possibility of failure of the inbuilt fire protection of the building.

Failure of power supplies have led to loss of life in lifts when the occupants are trapped in the stationary cage. Failure of emergency lighting will seriously impede evacuation, rescue and firefighting. Pumps feeding pressurised water mains may fail, cutting off the fireman's attack on the fire. Pressurised staircases or fire resisting doors may fail, allowing smoke and heat to enter escape routes. While there is little the fireman can do to prevent these unfortunate occurrences, he must be sufficiently adaptable and alert to the situation, in order that he may counteract any such unexpected development.

The firefighting plan which we have discussed today, is only a framework on which the individual circumstances of each high rise building may be hung. The location of the building, its occupancy, its structural fire protection, the availability of fire prevention, detection and firefighting equipment, will all play their part in preparing to deal with an emergency when it arises. No Fire Brigade can prevent a tragedy in a building which is poorly designed or badly constructed. The best situation that can be achieved for the Architect, Builder, Occupier and the Fireman is to ensure that there is adequate consultation before building commences and supervision during construction.

The training of fire marshalls from the building staff and the exercising of their duties is critical, as much of the initial Fire Service action will be influenced by the information they provide and the way they have done their job.

One thing is certain, the emergency will arise. It is the Fire Service forethought and preparedness which will determine whether it can be controlled and contained, thereby remaining comparatively small, or that it escalates to an incident of disaster proportions with all its attendant tragedy.

THE INDISPENSABLE HUMAN PRESENCE IN THE ORGANIZATION OF HIGH RISK PREMISES

by Lt. Col. Jean-Paul Cherix, Inspector, Fire Services,
Canton of Geneva

For some 20 years, we have, with considerable satisfaction, seen the basic research undertaken by many countries in the field of fire safety improve our ability to pinpoint the main causes of fires, and to understand how they spread and what their consequences are. During that time, manufacturers have worked feverishly to develop safety systems designed to prevent fires from occurring, or at least to limit their effects.

It must be acknowledged that, generally speaking, the arrival on the market of these systems, which are as varied as they are numerous, has brought an appreciate improvement in safety, particularly in enterprises and operations which entail special risks.

Nevertheless, investigations conducted following a number of recent fires have shown that the resulsts achieved by the introduction of new technology have not always come up to expectations, particularly given the considerable financial investment which they represent.

The main reasons for this partial failure are to be found in the ability or inability of those in charge of operations to fully understand the safety systems furnished by the manufacturer, often at the request of the national authorities.

In my view, the main shortcomings lie in : the selection of individuals responsible for safety, lack of professional training, lack of drills, inadequate technical inspections, over-sophisticated safety equipment, inappropriate equipment, unreliable equipment.

As a result, we have arrived at the paradoxical situation where :

- Man has sought and generally found technically valid fire-fighting systems.
- Man has placed on the market reliable, and often costly, facilities.-

But man, at the operational level, sometimes has difficulty in understanding the systems for which he is responsible.

It is important therefore that manufacturers, owners, operators and the authorities should conduct a very thorough analysis of various parameters referred to above, with a view to co-ordinating their efforts in order to alleviate this danger of a gulf between man and technology.

It is my hope today to make a modest contribution to a better understanding of such situations which, at least initially, may have been brought about by the wish in some quarters to replace man by an admittedly very sophisticated but nevertheless, limited technology.

I should like at this point to make it clear that our observations were made in establishments which were either large-scale or entailed special risks and where it was therefore necessary to tailor the security measures to the risks involved and to carry out regular checks.

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This category includes : hospitals and similar establishments, large educational establishments, high residential buildings (over 27 metres), theatres, cinemas, department stores, hotels, some industrial premises.

Let me also, in the interest of clarity, list the main features of safety systems which, in their everyday operation and, naturally, in the event of a fire, can cause problems for security personnel. They are, not necessarily in the order of the extent of the difficulty raised : automatic connection of the alarm to the fire service, automatic fire detection, detection system indicator board, automatic extinguishing system, emergency lighting - emergency generator, system for alerting internal fire-fighting and evacuation teams, automatic system for the announcement of evacuation and various safety precautions (partitions, fire-doors, lift recall, escalator shut-down, etc.).

The growing use of automatic alarm systems of the detection type, automatic extinguisher systems and emergency lighting has necessitated the establishment of an extensive human infrastructure of specialized personnel to carry out routine maintenance and, in the event of an emergency, to operate the various safety systems.

While, in general, most major enterprises have set up an adequate human infrastructure by appointing service heads of a high professional standard and properly trained staff, a large number of enterprises still do not have safety and maintenance teams who are, in our view, sufficiently well-trained. Consequently, in an emergency, the capacity to analyse and react is greatly reduced, with predictable consequences.

Some examples :

Bowling alley situated in a basement, with restaurant.- A fire breaks out and assumes such proportions that the public is unable to leave by the normal exits. In attempting to leave the establishment by the emergency exit, the public finds it to be blocked by materials which prevent it from being opened. In addition the emergency-lighting system has been disconnected. Result : seven dead. There was no installation inspection crew on the premises.

Fire in a two-storey shopping centre with underground car park.- A fire breaks out in a shop shortly after the shopping centre closes. Flames and smoke spread to the adjacent restaurant, which is open. The restaurant is on the ground floor and gives on to a terrace. The order is given to evacuate the premises, which is done, although in an uncontrolled and unsupervised manner. Two customers, both young men, decide not to use the emergency exits and go back towards the internal lifts leading to the parking area : two deaths. The establishment was partially equipped with smoke detectors and sprinklers with a direct push-button link to the fire service.

A new hospital (for the elderly) equipped with all the necessary systems (detectors, direct link with the fire department, emergency lighting, sufficient exits) is inaugurated.

A trained safety crew is also brought in.

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After the hospital has been in operation for six months, an inspector carrying out an official check notes that all the security staff have been replaced and that their successors have not been provided with any training.

Multi-storey downtown shopping centre regularly carries out partial evacuation drills.

Following action by an official service, a general evacuation drill with public participation, is organized. Observations made during the exercise : an alarm-button alerting the official services, actually used in the course of the exercise, does not function, a number of fire doors do not close, grossly inadequate technical checks.

These few recent examples - and there could be others - must not, however, detract from the considerable progress made in improving safety in high-risk establishments. While there is naturally room for improvement in some organizations, there are also many enterprises which have set up operational, inspection and evacuation crews, perfectly capable of dealing with the risks involved and affording considerable assistance to the fire services by responding very rapidly and successfully, and by notifying them. I should like to pay a well-deserved tribute to the heads of those enterprises an to the men and women who make up such teams.

Nevertheless, the problems observed must not be ignored. This is a matter of concern for heads of enterprises, security officers, public services, and the manufacturers.

Let us consider the tasks and responsibilities of each of the above.

Heads of enterprises have primarily responsibility for safety and must recognize that the often very considerable financial investment in safety equipment must be sustained and supplemented by a trained and sufficiently large human infrastructure. This responsibility of heads of enterprises is, of course, not new, but is perhaps different from what it was before the introduction of new safety technology.

Minimum requirements for a safety team

- knowledge of the premises,
- knowledge of problems peculiar to the enterprise (chemicals, sources of radioactivity),
- knowledge of security system : internal and external alarms, automatic detection, automatic extinguishing, emergency lighting, emergency procedures,
- appropriate action in the event of evacuation to a safe distance, initial response,
- maintenance of security systems, in co-operation with the technical services of the enterprises.

To dispense with this human infrastructure (in the area of inspections, alarms, fire-fighting and evacuation) can undermine the viability of the whole security system. Automatic safety systems have their limitations, and their reliability must be checked.

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Safety officers appointed by heads of enterprises

We are all aware of the difficulties involved in this position, which is often like being caught between the devil and the deep blue sea. I should simply like to point out that one of the most important tasks of these officials is to see to it that every measure is taken to ensure regular inspections of the whole security system by personnel who are familiar with it. It is in this area that, in my view, the greatest effort should be made. Too many fires spread due to insufficiently frequent inspections and inadequate maintenance. When using the term "inspection", it is necessary to understand what it actually entails. It does not mean, for example, simply checking the presence of installations; it also involves testing them by actually operating them and ascertaining their reliability.

Examples :

Special lock systems (double cylinder), installed to enable security teams and firemen to enter premises, must be tested in the course of inspections to ensure that they work properly. In this respect we have, on occasion, found locks deliberately blocked, unannounced modifications, etc., all of which could have appreciably delayed operations in the event of a fire.

Inspections must be thorough and precise. They are one of the corner-stones of the security structure of an enterprise, as is the organization of fire-fighting and evacuation teams, which are generally set up by the chief of security.

In both the areas of fire-fighting and evacuation, training of crews should include actual evacuation drills with the participation of the staff and the public. Only by such operations can the real viability of security systems be determined.

The Department of the Interior in Geneva, for example, instructed a large number of enterprises which received members of the public, in particular department stores, to carry out at least one evacuation drill involving the public each year, under the supervision of safety inspectors. Such operations have been taking place for a number of years and have yielded very important practical experience to both company officials and the representatives of the authorities. The very large majority of the population itself appreciate these exercises and co-operate very well.

Safety system manufacturers.- While the arrival on the market of many fire-safety systems is to be welcomed and those responsible for the design, production and marketing congratulated, I cannot help having some reservations regarding their use. Let me explain. Any potential buyer will be "conditioned" by the seller. If the seller is more interested in fire prevention than in sales, everything will certainly work out well. If, on the other hand, selling is the prime concern, the buyer can find himself with an inappropriate, over sophisticated and frequently very costly system. Any buyer who is not a specialist will therefore hesitate and, if he buys, will, in many cases, have to put up with a number of disappointments. Consequently, the "professional" must be aware of his responsibility. In the area of security, even systems regarded as simple are too complex when the time comes to use them. Everyone involved must be convinced of that.

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Official services.- As we all know, fire safety is a matter for everyone, so that the competent official services must not only adapt existing legislation to take account of new hazards, with the basic aim of saving human lives, but must also participate in the efforts made by : owners and manufacturers.

You see, I believe in direct assistance from the State, acting as a technical adviser. On the other hand, I reject the idea of a State or of "ivory tower" services which confine themselves to implementing legislation which is often too rigid, if not outmoded.

It is through healthy co-operation with private bodies, in a continuing dialogue, that the most effective solutions to industrial safety problems can be found. Changes in hazards and the highly technical nature of systems make such co-operation essential.

In which areas ? For example, for high-risk operations :

- at the planning stage, participation of safety principles by State officials and heads of enterprises;
- at the operational stage, participation by the State in the organization of security, and in fire-fighting and evacuation exercises.

In addition, the State must :

- carry out regular inspections of establishments, in principle once a year;
- organize, instruct and equip official fire services capable of providing assistance to establishments where fires break out, on the understanding that such services must not be regarded by heads of enterprises as responsible for security in their establishment, but rather as one of the components of the security system.

Conclusions

Safety, in particular fire safety, must be regarded increasingly as an integral part of the activities of an enterprise. The human element will always have a paramount role to play in prevention and fire-fighting operations. It is important, therefore, that the resources should be made available for the establishment of an adequate human-resource structure. Safety systems must of course be designed to meet the need for efficiency, be suited to the actual risks involved and, above all be understandable to the persons operating them. The State must also provide direct technical assistance for the organization of security systems in high-risk enterprises.