Title document

Heritage Under Fire

A guide to the protection of historic buildings

Second edition

Edited by Stewart Kidd

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Fire Protection Association
Bastille Court, 2 Paris Garden, London SE1 8ND

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Foreword

Since the first edition of this guide was published in 1990 the number of entries in the Government's lists of buildings of special architectural or historic interest has continued to grow. Fire, however, does not respect history or architectural merit, and, as recent years have shown, the number of these buildings damaged or destroyed by fire has also increased.

Although there is no evidence that historic buildings are a greater fire risk than other building types, their loss, and that of their contents, is particularly significant. Once a piece of our heritage is lost it can never be replaced. There is a continuing need for vigilance, and it is important that appropriate fire safety measures are taken to reduce the risk of fire as much as possible, and to provide an action plan should a fire occur.

The precautions taken should reflect the need to minimise interference with the structure, both internal and external, of historic buildings. Planning authorities and fire authorities should, therefore, deal flexibly and sympathetically with proposals for fire safety measures to historic buildings to ensure that changes are in character with the rest of the building and there is no unacceptable damage to the fabric. This guide will help them to do so.

This guide takes account of the lessons learned from the major fire at Windsor Castle; I am pleased that it repeats the recommendations of Sir Alan Bailey's report "Fire Protection Measures for the Royal Palaces". Both the Royal Household and the Historic Royal Palaces Agency have made good progress in implementing those recommendations. Of those considered urgent, almost all have now been implemented. Automatic fire detection is being extended to cover all palaces and the programme is due to be complete by 1997.

I congratulate the FPA and the Working Party on updating this guide. Everyone concerned has worked hard together to produce a very useful document; I commend it to all those who live in, work in or have responsibility for protecting historic buildings as an important source of information and practical advice.

Stephen Dorrell
Secretary of State for National Heritage

The United Kingdom Working Party on fire safety in historic buildings

Association of British Insurers
Association of Conservation Officers
Association for Studies in the Conservation of Historic Buildings
British Automatic Sprinkler Association
British Fire Protection Systems Association
British Fire Services' Association
Chief and Assistant Chief Fire Officers' Association
Department of the Environment
English Heritage
Fire Protection Association
Fire Research Station
Fire Service Inspectorate
Heritage Co-ordination Group
Home Office
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International Council on Monuments and Sites
Loss Prevention Council
National Trust
Royal Commission on Historic Monuments (England)
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
Society for the Protection of Ancient Buildings
Timber Research and Development Association

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English Heritage

Colin Packer
National Trust

Ron Bentley
Parliamentary Works Directorate

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Preface to the second edition

When this document was first published in 1990 all those involved in its production hoped that it would find its place on the bookshelf of not only those who are responsible for the management of historic buildings but also those like architects, planners and the fire service who play a role in helping to protect our heritage.

While we can derive some satisfaction from the fact that more than 2500 copies of the guide are in circulation, recent events prove that we still have a long way to go. Fires in a wide range of listed buildings suggest that not all the lessons have been learnt.

This second edition contains a much wider range of information and advice, put together in what we hope is an easily accessible fashion. In particular, we have incorporated the guidance and suggestions contained in the Bailey inquiry[†]. Virtually all the essential elements of knowledge needed to put in place a fire safety programme for all sorts of listed or heritage buildings can now be found in the document.

Stewart Kidd
Director, Fire Protection Association
London, 1994

[†] *Fire protection measures for the Royal Palaces,* Report by Sir Alan Bailey KCB, Department of National Heritage: HMSO, 1993.

17th century merchants' houses in Canterbury town centre

Introduction

This guide is published by the Fire Protection Association on behalf of the UK Working Party on Fire Safety in Historic Buildings. Formed in 1986 following the disastrous fires at Hampton Court and York Minster, it brings together representatives from 23 national and other organisations.

I am deeply indebted to those who have worked so hard and for such a long time to produce this document - its appearance signals a new awareness of the dangers of fire within the heritage field and I hope that all the organisations involved will feel able to use the information and advice to improve the levels of protection our historic buildings deserve.

It is necessary perhaps, to clarify the intent of the working party and hence the document. The greater part of fire legislation in the UK is dedicated to the protection of life, it has always been the declared aim of governments of all hues to assure the safety of life and any requirements to provide protection for property have tended to be of secondary importance. This is, of course, as it should be. It is perhaps ironic that the current state of legislation means that one is considerably safer in a hotel or cinema than one is at home. The statistics bear out this suggestion. In 1988, there was a total of 915 fire deaths; of these 732 took place in dwellings and only 73 in other occupied buildings. (There were another 110 deaths outdoors or in derelict buildings.)

All this means that efforts by the authorities (local and national) have tended to be aimed at reducing this appalling waste of life. This has resulted in safer public buildings and places of work, but what has been lacking from legislation are firm requirements for the protection of buildings and their contents. This is a task which Parliament has always left to property owners and their insurers.

This guide is intended to redress at least part of the balance. Although it does not shirk from addressing essential matters of means of escape and life safety, it is primarily intended to help the owner or occupier of an historic building implement a set of procedures which will reduce the possibility of fire breaking out and in the event of a fire, ameliorate the impact on the building and its contents.

The guide will also be useful to those who have a professional involvement with historic buildings and will perhaps suggest alternative ways in which fire safety standards can be complied with while at the same time minimising the need to implement expensive and destructive changes to the fabric of heritage buildings.

Salvage and damage control are covered only in outline within this document, as it is felt that these are subjects where a little learning might well be injudicious. More detailed information on this subject can be obtained from a number of specialised agencies and it is hoped that a future publication will describe in detail the protection of buildings and their contents from the aftermath of a fire.

Within the guide can be found an extensive listing of sources of further information and, as I have found to my delight since taking on responsibility for this work, if there is one feature which marks out those who care about our heritage, it is that no one is ever too busy to answer questions or provide help.

I welcome further debate on this subject and pledge the FPA's support to any measures which will help to reduce the senseless loss of irreplaceable treasures.

Stewart Kidd
Director, Fire Protection Association
London, 1990

1. Plan of action

This plan is based on the recommendations made in Sir Alan Bailey's Report[†] following the Windsor Castle fire and the priorities and order follow those published in the Report's Summary. Full details of the strategic recommendations are given in Annex 8.

1. Each historic house or premises should have a written fire safety policy statement. Effective internal mechanisms should exist to ensure that the policy is properly implemented and the policy should cover not only the normal operating regime of the location but take into account special or occasional events.
2. Each location should appoint an individual at senior level as Fire Safety Manager with specific responsibility to implement the fire safety policy.
3. Where appropriate, particularly in larger premises, the fire safety manager (who may have other duties) may be assisted by a full-time, specialist, fire officer. (In some locations, this role may be combined with a similar activity such as security.)
4. Each historic house or location should compile a fire safety manual setting out its strategy and detailing its plans in case of fire and as a basis for training. Locations should also maintain a log book to record all fire-related events such as training, drills, inspections and equipment maintenance.
5. Premises should undertake (or commission from a reputable consultancy) a detailed fire risk assessment. This should make recommendations for fire safety improvements consistent with the preservation of historic fabric.
6. The installation of a modern, reliable fire detection and alarm system should be seen as a high priority. Such systems should be closely monitored by senior management to ensure that unwanted alarms do not undermine confidence in the system. Maintenance of such systems should be to the highest standard.
7. Following the fire risk assessment, managers should establish a priority for implementation of physical fire safety improvements including establishing or upgrading fire compartments, segregation of areas of high fire risk and providing protected escape routes.
8. Where legally required, fire certificates should be obtained and their requirements fully complied with.
9. Systematic and effective training programmes should be introduced to ensure that all staff know how to minimise fire risks, how to raise the alarm in case of fire and to provide enough trained staff to tackle incipient fires quickly.
10. Where private apartments exist they should be included in fire surveys and re-inspected at least every five years. (These inspections should include electrical equipment and the occupants should be given the opportunity of obtaining reliable fire safety advice.)

[†] *Fire protection measures for the Royal Palaces,* Report by Sir Alan Bailey KCB, Department of National Heritage: HMSO, 1993.

Book chutes at Lanhydrock House in use in an evacuation exercise

11. Clear fire safety requirements should be included in all contracts for building, maintenance and other work and for special events. Management must check to ensure that the requirements are being carried out.

12. Larger locations should form and train a salvage/damage control team.

13. Management should liaise regularly with local fire brigades on risk management, fire fighting and salvage. Exercises should be arranged periodically.

14. Consideration should be given to the advantages offered by sprinkler systems for the protection of areas where effective compartmentation or segregation cannot be carried out or for high-risk areas.

15. A proper programme of preparation and safe storage (possibly off-site) of site photographs, architectural records and other information should be put in place.

2. The problem

Totnes town centre, 4 September 1990

Fire threatens all buildings and its effects can be disastrous in both human and economic terms. In the case of an historic building there is a further dimension - the loss of property that forms part of a cultural resource which is finite, irreplaceable and whose architectural and historical integrity can be destroyed as easily by inappropriate fire precautions as by fire itself. The introduction of appropriate and sensitively applied fire precautions should therefore be regarded as an integral part of a strategic plan for long-term preservation of any historic building.

Fire can cause the total destruction of a building and its contents in only a few hours; areas not directly damaged by flame or heat may be damaged by smoke, dirt and falling debris or by the huge volumes of water which may be used in fighting the fire. Following the fire, the building may be structurally unstable, open to wind, weather and vandalism, and susceptible to decay caused by the high residual moisture content in the fabric.

In the last decade historic buildings of national and international importance in the UK have been seriously damaged by fire at a rate of more than one per year. Details of many of these disasters are given in Annex 7 and they emphasise that although there is no evidence to suggest that historic buildings as a class are at greater risk of fire than other buildings, when a fire does occur it exposes the vulnerability of historic buildings and their contents to fire and its aftermath. Although many lessons have been learned and approaches to fire safety in historic buildings grow more sophisticated, one simple fact remains - most fires occur as a result of human action or negligence.

The fire at Windsor Castle (1992) was no exception: it was probably caused by a curtain being ignited by a wall- mounted spotlight which was too close behind it. The resulting damage is expected to cost at least £30-40 million to repair.

These disasters highlight the need for effective fire precautions to minimise the risk of a fire occurring, and to mitigate losses in the event of fire.

However, as already mentioned, historic buildings can be disfigured or damaged as easily by inappropriate fire protection measures as by fire itself.

Traditionally, fire protection in buildings has been largely based on structural (or "passive") fire protection where the spread of fire and smoke is controlled by constructional

elements such as walls, doors and floors. In historic buildings this approach often involves the need to upgrade these elements to achieve a specified period of fire resistance and this can adversely affect the architectural character of the building and involve an unacceptable degree of disturbance to its fabric.

Problems may occur when the use of a building is changed - for example, a country house converted to a school or hotel, or a church turned into a dwelling, or used as a venue for entertainments.

Difficulties will often arise when additional staircases for means of escape are required. The incongruity of modern fire safety "hardware" such as exit notices, emergency lighting, fire detection, warning and suppression equipment is another facet of this problem. There may thus be a conflict of interests between, on the one hand, the need to provide adequate fire safety and, on the other, the need to preserve the architectural and historic character of the building.

In such cases a logical and systematic fire safety risk assessment followed by a fire engineering approach is needed to reveal alternative methods of achieving adequate, appropriate, and cost-effective standards of fire safety.

The analysis and evaluation of the problems that exist in a specific building is the only way to approach the problems of specifying a package of fire precautions and management actions for that particular building. (See Chapter 10, under 'Means of escape'.)

For example, in some situations it may be possible to adopt an alternative approach which places more emphasis on the early detection of fires to facilitate evacuation of the occupants at the earliest possible opportunity thereby permitting conventional standards of fire resistance to be reduced. This does not imply a lowering of safety standards but the achievement of a comparable standard by an alternative approach more suited to the needs of the building.

There is, of course, a need to differentiate between provisions for life safety and measures intended to protect property. Whilst standards of fire safety required for the safety of the occupants of the building will generally help to reduce damage to property in the event of fire, additional measures may well be needed to minimise the potential for loss in respect of the building and its contents.

Measures needed to improve fire safety should be arranged according to priority. Some may be needed immediately. Less important ones may be delayed until there is a suitable opportunity.

When fire precautions involving alterations[†] to the building cannot be avoided, careful and sympathetic design is needed to minimise the impact these have on the architectural and historic character of the building.

In some cases, a more satisfactory approach will be to avoid the circumstances that bring about the requirements for alterations.

This publication draws on the lessons learned in recent fires to provide a concise guide to owners, occupiers and managers of all types of historic buildings on the actions they should take to ensure that our built heritage remains for the use and enjoyment of future generations.

[†] If the building is listed, Listed Building Consent may be required and owners should seek advice from their local authorities' conservation or historic buildings section or other appropriate organisations. Owners of unlisted buildings in Conservation Areas should also refer to the planning authority.

3. Fire

Its Nature and Behaviour

A fire occurs when a fuel (such as wood or paper) is raised to its ignition temperature by a source of heat (such as a match flame) in the presence of oxygen. All three factors, heat, oxygen and a combustible substance or fuel need to be present for a fire to occur. The removal of any one factor will cause the fire to go out, i.e. removal of the heat by the application of water, exclusion of the oxygen by smothering or the physical removal of the combustible material.

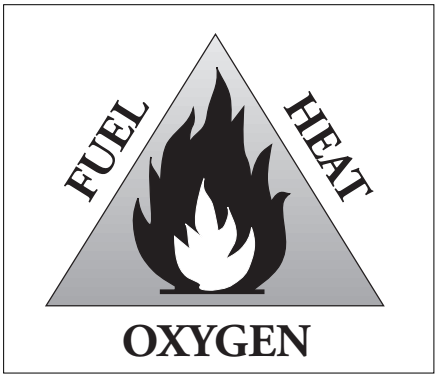


Fig. 3.1. The fire triangle

If action is not taken to extinguish or control a fire, it will continue to burn whilst heat, oxygen and fuel are present. It will also spread to adjacent combustible material by conduction, convection and radiation of heat.

Smoke and hot gases (which are the products of combustion) will rise until they reach a horizontal surface such as a ceiling or roof, when they will spread out laterally, forming a layer (known as mushrooming), until they reach a wall. When the sideways movement is stopped by a wall, the layer of smoke will start to thicken, as a result of being confined and the layer will increase in depth towards the floor, reducing the height of the clean air layer in the room. This will continue, until the smoke reaches an opening such as a window or doorway, through which it can pass. The smoke and hot gases will continue to build up, resulting in the further spread of fire. It is for this reason that it is important for certain walls in a building to be imperforate with self-closing, fire-resisting, smoke-stop doors, to curtail the spread of fire and to ensure that adequate means of escape are available, in the event of a fire. If the smoke and hot gases are not confined by fire-resisting walls and closed doors, fire will spread until it reaches an unobstructed upward route, such as a staircase or a lift shaft[†]. More particularly smoke and hot gases will discover any hidden voids or cavities, which can result in the undetected fire spreading and the smoke logging of areas far removed from the original source of fire.

[†] Passage to free air at high level in lift shafts is a requirement in BS 5655: *Lifts and service lifts. Part I: 1986: Safety rules for the construction and installation of electric lifts.*

The Spread of Fire

Fire can spread when heat is conducted through materials (such as metalwork) and also by radiation when a heated surface can ignite materials some distance away. It should be noted that even non-combustible materials such as iron and steel lose their strength when heated and will eventually distort and perhaps collapse.

Fire spread occurs when hot combustion products move extensively through a building. The most serious spread takes place when the smoke contains large quantities of unburnt gases. When mixed with air these can ignite suddenly, creating an explosive effect. When this takes place, all the combustibles in a room can ignite spontaneously.

The provision of fire and smoke ventilation reduces the speed at which a fire spreads and helps those fighting it. Heat can be prevented from building up excessively in roof spaces if fire ventilators with thermal latches are incorporated. With care over their siting and design, ventilators can frequently be incorporated unobtrusively. A design for a lead-covered ventilator is described by the Lead Development Association in *Lead Technical Note Number 6.* When buildings are being reroofed the advantage of providing a means of ventilation should be considered.

Special Problems of Historic Buildings

In the context of fire safety there are two particular areas where problems arise:

Firstly, the construction and form of historic buildings frequently incorporate features which can assist in the rapid development and the hidden spread of fire, for example, exposed timber floor structures, walls lined internally with combustible materials such as wood panelling, or externally with weather-boarding and roofs of shingles or thatch. Modern buildings incorporate the constructional arrangements (mentioned previously) to control the development and spread of fire and smoke, to protect escape routes, and to prevent premature structural failure. Such arrangements are invariably absent in older buildings.

There may be continuous and interconnecting voids behind panelling and wall linings or undivided roof spaces through which fire and smoke can spread quickly and undetected. Timbers built into old chimney breasts or close to flues can present further hazards. In addition, the fire resistance of constructional elements (especially doors) can be adversely affected if they are in a poor state of repair.

Measures needed to improve fire resistance should be arranged according to priority. Some may need to be implemented immediately. Less important ones may be delayed until there is a suitable opportunity. It may be possible to enhance structural fire protection by increasing the fire resistance of elements, by inserting fire stopping and by providing cavity barriers without detriment to the fabric of the building. This can often be carried out during maintenance work (such as rewiring or reroofing) at small expense. One example of this is the provision of cavity barriers in roof spaces. Frequently roof spaces are divided by perforated cross walls beside chimney stacks. They can be made into cavity barriers with little difficulty by the insertion of fire-stopping and fire-resisting doors. Where such walls do not exist, roof spaces can be subdivided by fire-resisting curtains or blankets. Another example is within floors where voids between joists may need to be fire-stopped where they bear on partitions.

The form and layout of the building may increase the difficulty of evacuation or hamper the fire brigade's rescue and fire-fighting operations. Its location, which may be remote,

will affect the time taken for the fire brigade to attend and inadequate supplies of water on site may cause further difficulties.

The second problem area concerns the measures adopted to provide the necessary standards of safety, and the impact these have on sensitive architectural and historic settings.

As already stated, many of the problems occur when the use of a building is changed.

Difficulties will often arise when additional staircases for means of escape are required. The incongruity of modern fire precautions hardware such as exit notices, emergency lighting, fire detection, warning and suppression equipment has already been mentioned.

In cases of conflict between the needs of fire protection and the need to minimise the intrusion into historic structures a logical and systematic approach to the assessment of fire safety requirements is needed to reveal alternative methods of achieving adequate, appropriate, and cost-effective standards of fire safety. The analysis and evaluation of the problems that exist in a specific building make it possible to specify the appropriate package of fire precautions and management actions for that building.

For example, in a building open for public viewing a lower standard of fire resistance of structural elements may be acceptable where an automatic fire detection system is combined with adequate management procedures to ensure that the occupants can be evacuated before a fire reaches a size which would endanger life.

4. General legislation

Fire safety legislation applied to a particular historic building invariably depends on the use to which the building is put. As historic buildings may be used as hotels, schools, offices, shops, residential care premises, or even factories, the relevant legislation which applies will differ dramatically. (The only premises which are exempt from general fire precautions legislation are buildings occupied as single private dwellings.)

For example, a licence (which will take account of fire safety) under the Licensing Act 1964, 1976, 1988 or the Local Government (Miscellaneous Provisions) Act 1982, may be needed if the premises are put to commercial use involving the sale of alcohol or provision of entertainment

If the building is to be used for certain specified purposes, for example as a hotel, office, shop or factory, then a fire certificate[†] will be required, unless the premises are specifically exempt from the requirement by the relevant designation order or by the local fire authority. Even so, exempt buildings will still need to have adequate means of escape and fire-fighting equipment.

Even when premises are put to a use whereby no fire certificate is required, fire authorities have powers to prohibit or restrict their use if they are of the opinion that there will be a serious risk to persons in case of fire. These powers extend to any use of premises other than as a single private dwelling (which does not require a fire certificate).

Legislation Relating Specifically to Historic Buildings

Most historic buildings are statutorily listed under the conservation legislation and any alterations, external or internal, affecting their character as buildings of special interest, which may include those necessary or desirable to improve fire safety, must be the subject of an application for Listed Building Consent to the local planning authority.

Applications affecting Grade I and Grade II* buildings in England must be notified by the planning authority to English Heritage and may not be approved without concurrence of the Secretary of State for National Heritage. (Similar arrangements exist in Scotland, Wales and Northern Ireland.)

Informal advice is usually available from the local planning authority's Conservation Officer or Historic Buildings Adviser and from officers of English Heritage, Historic Scotland or CADW direct in the case of higher-grade listed buildings

In addition to Planning and Listed Building controls, alterations and changes of use may be subject to the Building Regulations and advice should be sought from the local authority's building control department.

Although most of the advice and information contained in this publication applies throughout the United Kingdom, legislation relating to historic buildings obviously differs as do the bodies charged with enforcing such legislation; space precludes a detailed

[†] Fire certificates are required under the Fire Precautions Act 1971 (see Annex 3 for further information). Fire certificates specify requirements for means of escape, means for raising the alarm, and means for fighting fires. They may also prescribe other fire safety requirements.

description of the legislation protecting historic buildings and sites here, but compliance is strongly recommended.

Annex 4 lists details of specific legislation and Annex 6 gives addresses of government departments which may be useful.

A number of Acts of Parliament and other Statutory Instruments may affect the various uses to which historic buildings are occasionally put. These include:

- The Theatres Act 1968;
- The Local Government (Miscellaneous Provisions) Act 1982;
- The Civic Government (Scotland) Act 1982;
- London Government Act 1963.

Theatres Act 1968

The Theatres Act 1968 requires that premises shall not be used for the public performance of a stage play except in accordance with the terms of a licence granted by the local authority. The application can be for a full licence where plays are held frequently or an occasional licence when plays are held infrequently. The terms of licence are usually more stringent for a full licence than for an occasional licence. Most local authorities require the application for a full licence to be submitted to the Clerk of the Authority, the Chief Police Officer and the Chief Fire Officer 21 days before the date of the performance(s) of a stage play. An application for an occasional licence has to be made to the Clerk of the Authority only (i.e. not the Chief of Police or the Chief Fire Officer), 14 days before the date of the performance.

(a) The definition of a play according to section 18, paragraph (i) of the Act is:

(i) Any dramatic piece, whether involving improvisation or not, which is given wholly or in part by one or more persons actually present and performing and in which the whole or a major proportion of what is done by the person or persons performing, whether by way of speech, singing or action, involves playing a role; and

(ii) Any ballet given wholly or in part by one or more persons actually present and performing, whether or not it falls within paragraph (i) of this definition.

(b) Safety requirements: When a performance falling within the definition of a play is given, the local authority will require certain standards of safety to be met before the licence can be issued. These may vary between authorities, but the usual basis amounts to the requirements outlined hereunder in addition to those indicated in chapter 10, "Means of escape".

For technical standards see the *Guide to fire precations in existing places of entertainment and like premises* published by the Home Office in March 1990 and revised in August 1994.

The Local Government (Miscellaneous Provisions) Act 1982

This Act requires that an Entertainment Licence be obtained before premises are used for public dancing or the performance of music or any public entertainment of like kind. It does not apply to any music performed in a place of public religious worship or performed as an incident of a religious meeting or service. The fire safety requirements for the issue of an Entertainment Licence are similar to those required for a Stage Play Licence. No fee is payable for a licence for entertainment in a church hall, chapel hall or other similar

Some older buildings offer little internal resistance to spread of fire

building occupied in connection with a place of public religious worship. An application for a licence has to be made to the Clerk to the local authority, the fire authority and the Chief Police Officer, at least 28 days before the event. Each local authority department involved will then inspect the premises and if they are satisfied with the standards of public safety, means of escape in case of fire and the standard of hygiene, the licence will be granted. If they are not satisfied that the required standards have been met they will indicate what steps are to be taken to make good the deficiencies. The local authority may require a copy of the application to be exhibited outside the building and they may also require it to be advertised in the local press. Some authorities require plans of the building for which the licence is required. These can be in the form of simple line drawings giving dimensions of the building and the location of the exits.

The Civic Government (Scotland) Act 1982

The Civic Government (Scotland) Act 1982 requires a licence to be obtained before any form of entertainment can be performed on church premises. The procedure for obtaining a licence is similar to that required under the Local Government (Miscellaneous Provisions) Act 1982 in England and Wales except that application is made only to the Clerk of the district or islands council.

London Government Act 1963

Schedule 12 of this Act provides that licences for entertainment and Stage Play Licences issued under the Theatres Act 1968 are obtainable from the Clerk to the borough council. The exemption from the requirement for a licence for music in a place of worship etc. does not apply, so a licence must be obtained for musical performances in church. Except where the licence is for an entertainment of an educational or similar character or is given for a charitable or other like purpose, a fee is payable. It is for the licensing authority, i.e. the council, to determine in each case, subject to appeal to the courts, whether the entertainment is such that the applicant will be exempted from payment of a fee.

Where there may be a conflict between measures which may be required under the Fire Precautions Act 1971 (or related legislation) and Listed Building interests, a meeting of all parties should be convened to resolve the conflicting aims.

Crown Premises

The legal position of premises owned or occupied by the Crown differs in some circumstances from that described earlier in this chapter. Advice can be obtained from the central or local government departments responsible for the legislation, or where appropriate from the Department of the Environment. In the case of certificatable premises, assistance may be obtained from the Crown Premises Inspection Group of HM Fire Services Inspectorate. General advice can be obtained from the Conservation Unit at the Department of National Heritage.

England and Wales

HM Inspector of Fire Services
Fire Service Inspectorate
Crown Premises Inspection Group
Home Office
White Rose Court, Oriental Road
Woking, Surrey GU22 7LG

Tel: 01483 776263
Fax: 01483 776219

Scotland

HM Inspector of Fire Services
The Scottish Office
St Andrew's House
Edinburgh EH1 3DE

Tel: 0131 244 2336
Fax: 0131 244 2683

The position of Crown immunity may however change in the light of the Citizen's Charter which states that the Crown should not be immune from enforcement action unless there are special reasons to justify it, and in the light of recent reviews of fire safety legislation which have recommended removal of Crown immunity.

The Fire Precautions Act

The 1971 Fire Precautions Act was the first modern piece of legislation intended to deal solely with fire safety matters. It was originally intended that the provisions of the Act (which allow fire authorities to issue fire certificates to 'designated premises') would eventually cover all non-domestic premises or occupancies. As it happened, many of the anticipated orders designating premises were never issued and at the time of publication, for practical purposes, the Act only controls premises used as hotels, boarding houses, offices, shops and railway premises.

In 1987 the Act was amended by the Fire Safety and Safety of Places of Sport Act the provisions of which came into effect on 1 January 1988.

There is a summary of the powers of the fire authorities as they relate to fire certificates in Annex 3.

Fire Precautions (Places of Work) Regulations

Parts of two European Council Directives - 89/391/EEC and 89/654/EEC - which directly affect fire safety in the workplace may be implemented in 1995. The Directives contain several features which are not covered by existing United Kingdom fire safety legislation but which - subject to public consultation and Government approval - are to be included in proposed new legislation entitled the Fire Precautions (Places of Work) Regulations.

These Regulations would represent an important step towards bringing general fire precautions for workplace buildings under a single piece of legislation. In conjunction with the Building Regulations 1991, the Management of Health and Safety at Work Regulations 1992 and the Workplace (Health, Safety and Welfare) Regulations 1992, they should establish an improved minimum level of fire safety at work. For details of the possible content of the Places of Work Regulations see Annex 13.

5. Measures to ensure fire safety

Hurst Green church fire, April 1988. The fire was started deliberately
Photo: Surrey and South London Newspapers

Arson

Malicious fire raising (by vandals, disgruntled employees, thieves or even by visitors) is one of the leading causes of fire in buildings. As historic buildings are often chosen as targets by arsonists, the dangers of arson (and consequent need for precautionary measures) cannot be overstated. Advice on arson and security is contained in Chapter 12 and additional information on security measures in Annex 12.

Chimneys and Flues

Fireplaces in historic houses are often beautiful structures forming an intrinsic part of the house's design. Over the years however their flues may have become fire hazards. Open fires are not to be recommended but, if they are to be used, the following points should be considered:

- Where flues have become defective as a result of decayed pargeting or brickwork, these deficiencies may permit heat to pass into the roof spaces or floor voids and ignite the timbers. Floor or ceiling joists may have been built into the chimney's structure and timber subjected to continuous heat in this way may smoulder and even burst into flames.

HOT WORK PERMIT

(Not necessarily applicable to a normal production process)

APPLIES ONLY TO AREA SPECIFIED BELOW

BUILDING _____ FLOOR _____

NATURE OF THE JOB (INCLUDING EXACT LOCATION)

_____

THE ABOVE LOCATION HAS BEEN EXAMINED AND THE PRECAUTIONS LISTED ON THE REVERSE SIDE HAVE BEEN TAKEN.

DATE _____ *TIME OF ISSUE OF PERMIT _____

*TIME OF EXPIRY OF PERMIT _____

SIGNATURE OF PERSON ISSUING PERMIT _____

SIGNATURE OF PERSON TO WHOM PERMIT IS ISSUED _____

*(It is not desirable to issue hot work permits for protracted periods; for example, fresh permits should be issued where work carries on from morning to afternoon).

TIME STARTED _____ TIME FINISHED _____

FINAL CHECK UP

Work area and all adjacent areas to which sparks and heat might have spread (such as floors above and below and on opposite sides of walls) were inspected continuously for at least one hour after the work was completed and were found fire safe.

SIGNATURE OF EMPLOYEE CARRYING OUT FIRE WATCH _____

AFTER SIGNING RETURN PERMIT TO PERSON WHO ISSUED IT

PRECAUTIONS

(The person carrying out this check should tick as appropriate)

- ❑ Where sprinklers are installed that these are operative.
- ❑ Cutting and welding equipment in good repair and adequately secured.

PRECAUTIONS WITHIN 15 m OF WORK

- ❑ Floors swept clean of combustible materials.
- ❑ Combustible floors protected by wetting down and covering with damp sand or sheets of non-combustible material.
- ❑ Combustible materials and flammable liquids protected with non-combustible curtains or sheets.
- ❑ All wall and floor openings covered with sheets of non-combustible material. All gaps in walls and floors through which sparks could pass covered with sheets of non-combustible material.
- ❑ Where work is above floor level, non-combustible curtains or sheets suspended beneath the work to collect sparks.

WORK ON WALLS OR CEILINGS

- ❑ Combustible constructions protected by non-combustible curtains or sheets.
- ❑ Combustibles moved away from opposite side and clear of any metal likely to conduct heat. (Where metal beams are being worked on, and extend through walls or partitions, precautions must be taken on the far side of such a wall).

WORK ON ENCLOSED EQUIPMENT (Tanks, containers, ducts, dust collectors etc.)

- ❑ Equipment cleaned of all combustibles.
- ❑ Containers free of flammable vapours.

FIRE WATCH

- ❑ Provision for the attendance of an employee during and for one hour after completion of work. Such employee being supplied with extinguishers or small bore hose and trained in the use of such equipment and in sounding an alarm.

SIGNATURE OF PERSON CARRYING OUT THE ABOVE CHECK _____

Fig. 5.1. Sample hot work permit

- Specialist advice should be sought on the condition of chimneys and consideration given to the installation of flue liners before the chimneys are re-used. If in day-to-day use, they should be swept regularly.
- Sparkguards should be fitted to all open fires; these should comply with BS 3248: *Spark guards for use with solid fuel appliances.* (See Annex 2.)

Contractors

There are many cases of serious fires in historic buildings being caused by the careless actions of building contractors.

As a principle there should be a presumption against the use of hot work on or within 6 metres of a building. Other alternative, acceptable methods should be considered. (The Lead Sheet Association has already reviewed installation procedures and alternatives to hot working methods, in an attempt to deal responsibly with the problems hot working creates.)

If hot work is unavoidable stringent restrictions should apply until a hot work permit is agreed, with permit procedures stated clearly in writing (Figure 5.1). Assignment of responsibility, to a named senior member of staff, for enforcement of the permit system is essential. Hot work arrangements must include the provision of any additional fire-fighting equipment together with implementation of other necessary fire precautions. Competent monitoring of the possible spread of fire during the whole period such tools, processes or equipment are in use and for a period not less than two hours after cessation of such use is essential. Due regard must be paid to weather conditions, in particular wind speed and direction.

Examples of fires started by contractors include:

- woodwork ignited by lighted blowlamp being used carelessly for removing paintwork;
- woodwork ignited by Primus stove;
- woodwork surrounding fireplace ignited by burning rubbish;
- flammable vapours from adhesives ignited by pilot light;
- sparks from oxy-acetylene cutting equipment fell down shaft and ignited waste;
- faulty electric lead to lamp ignited roof timbers;
- workmen set light to roof timbers whilst relaying lead;
- woodwork ignited by electric paint stripper;
- ignition of flammable vapours from solvents in pesticides used as a spray treatment for insects causing fire in timbers;
- high intensity halogen lights ignited packing materials;
- spontaneous combustion in folded, stored tarpaulins.

Occupiers must be fully aware of the vulnerability of an historic building to damage by fire during the course of repair or conversion work and all possible precautions should be taken while the work is in progress.

These precautions include (as necessary):

- Initial consultations with architect, surveyor, local planning authority and insurer. This should include clear allocation of responsibilities for issue and receipt of the hot work permits.

- Non-flammable solvent-type paint stripper should be used wherever possible (in preference to the use of blowlamps or electric hot air blowers).
- When work with a blowlamp is essential this should cease at least 1 hour before the end of the working day. Thorough checks for smouldering fires should be made during the next 2 hours.
- Regular checks of the workplace by senior personnel.
- Combustible material in the vicinity of any work should be removed. If this is not possible, it should be protected.
- At least two fire extinguishers of the right type should be provided close at hand during these operations.
- If it is essential to use oxy-acetylene or LPG-powered equipment, this should be secured to a wheeled trolley stored out of doors when not in use.
- Special care is required when work involves hot bitumen or similar material.
- If work makes it necessary to block corridors, stairways and exits forming a means of escape, then an adequate alternative must be provided and signposted.
- Ensure that access to fire-fighting facilities, such as fire extinguishers, hoses, hydrants and emergency water tanks, are not obstructed by building materials, equipment and scaffolding.
- The work of the contractor should be carefully supervised by a responsible member of staff who has the authority to dictate the fire precautions which will be taken, ensure work is not carried out carelessly and operate the fire-fighting equipment.
- Permit to work system (see Figure 5.1).
- Control of halogen-type portable floodlights which can ignite flammable vapours.
- All contractor personnel must be conversant with the method of raising the alarm in the event of a fire and locations of telephones or other equipment for calling the fire brigade.
- Hot work permits should also take into account the presence of fire detection equipment and the possibility of false alarms.
- Post hot work checks and monitoring of the work site by a responsible person for at least two hours after work ceases - even if all appears safe and cool.
- Use of non-combustible protective coverings.

In Crown-owned or -occupied buildings, strict compliance with published guidance for contractors is required. Useful advice for the prevention of fire in buildings undergoing renovation can be found in *Fire Prevention on Construction Sites,* the Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation published by the Loss Prevention Council with the Building Employers Confederation and the National Contractors' Group.

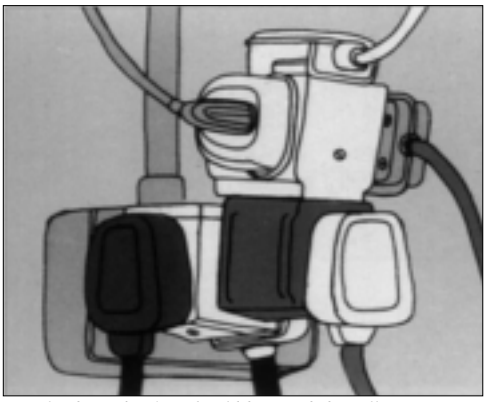
Cooking

Most cooking fires occur during frying processes. If a pan is left unattended, oil may overheat or boil over onto the gas flame or element and ignite. Boiling over can also be caused by putting wet food such as chips into the hot fat or oil. Pans should never be filled more than one-third full. Other causes of fires include clogged grease filters or hoods and improperly maintained fuses or fittings. It is essential to ensure that the spaces around

cookers are kept clean and free of grease. Ductwork should also be regularly inspected and cleaned frequently. This can be made easier if ducts are provided with access points or inspection hatches. Care should be taken to ensure that an appropriate type of fire extinguisher is available. Powder, foam or carbon dioxide are all acceptable for this purpose. Fire blankets should be available in all kitchens. If large commercial-type ranges are being installed consideration should be given to installing fixed dry powder or foam fire fighting systems. For further advice on portable fire extinguishers, see chapter 10 and Figure 10.1.

Electrical Installations

Electrical faults are a common cause of fire in all buildings and the likelihood of a fault occurring increases with the age of the installation. Danger signs include: obsolete or damaged plugs and sockets, switches and fuse boxes; overloaded sockets; rubber-insulated or lead-covered wiring; worn flex; taped connections; timber channels for wiring.



Overloading of sockets should be avoided at all costs

Electrical installations should be inspected and tested in accordance with IEE Regulations by a qualified electrician, who should carry out any necessary repairs or rewiring. All electrical inspections should be clearly recorded in a log book.

It is worth noting that if rewiring is being undertaken, this can be a convenient time to undertake additional passive fire protection measures such as fire-stopping in voids or roof spaces.

Sufficient sockets should be provided so that appliances do not need excessively long flexes and at the same time this will ensure that there is no need for adaptors to allow more than one appliance to be connected to a socket. Overloading of sockets should be avoided at all costs.

The electricity supply should be disconnected to sections of the building which are not in use. (This of course, does not apply to intruder alarms or fire detection systems.)

Combustible materials (particularly curtains and decorations) should be kept well clear of lights and heaters.

Great care should be taken to ensure that any electric heaters do not pose a fire hazard. As a rule of thumb, devices other than fan heaters, oil-filled radiators or night-storage heaters should be viewed with caution (see below).

Fixed Heating Installations

It is strongly recommended that, whenever structural conditions permit, historic buildings should be heated by means of modern central heating systems using gas or oil-fired boilers. Prior to making any decisions about changing heating systems, insurers should be consulted and specialist advice obtained.

Central heating systems should be installed in accordance with the relevant British Standard. The presence of water may cause a hazard to the fabric of buildings and it is essential that a high standard of maintenance is carried out by qualified and competent contractors.

Lightning

Historically, churches have been prone to damage from lightning strike and consideration should be given to protecting all historic buildings against this possibility.

The supply and installation of lightning protection equipment (lightning arrestors or rods) is a subject for specialist advice and individual considerations applied to the design of the method of protection.

Lightning protection should be provided and maintained in accordance with established standards, for example BS 6651:1985: *Code of practice for protection of structures against lightning,* or other well established principles.

Consideration should also be given to the possible effects of lightning strike through TV aerials or dishes. It should be emphasised that a poorly installed or maintained lightning protection system poses dangers to both people and the building. Regular maintenance by a specialist engineer is essential. The Bibliography in Annex 1 lists a useful source of further information.

Portable Heaters

Portable heaters using paraffin oil or liquefied petroleum gas are a serious fire hazard and their use is to be avoided. If portable heaters are unavoidable and essential, they should be of the electrical convection type fitted with thermostatic controls, suitably installed and properly maintained. Under no circumstances must portable heaters be refilled while they are alight.

Smoking

The existence and enforcement of non-smoking policies must be made known to all visitors and contractors and included in contract documents. While carelessly discarded smoking materials are still one of the main causes of fire in living accommodation, improved controls in historic buildings have secured a decline in the numbers of fires attributed to this cause. Whenever practicable, and this will depend on the use to which the building is put, smoking should be banned and this fact should be made known to visitors. Consideration should be given to the need for "No Smoking" signs and ashtrays at entrances to buildings. If smoking is permitted, it should, if at all possible, be restricted to specific areas and strict attention should be exercised to its control.

Wood-Burning Stoves

The slow-combustion stove can be an attractive form of heating but certain precautions must be taken:

Flammable liquids should not be used to kindle the fire. A gas poker should be used if possible.

Green or unseasoned wood makes chimney fires more likely - from tar and other deposits. This means that chimneys must be swept more frequently.

6. Fuel for the fire

Thatch fire at Micheldever. Thatch demands particular precautions against fire
Photo: Steve Osborne-Brown

Fuel Supplies

Oil, petrol, butane or propane used as a fuel for heating, cooking and lighting installations or to power electricity generators are relatively easy to ignite and can quickly become involved in a serious fire. Such fuels must therefore be stored under specified safe conditions. (See Annex 5.)

All fuels (including coal and logs) must be stored away from buildings. Some authorities on historic buildings suggest that all fuel must be kept outside buildings.

Furnishings and Fittings

The amount and quality of furniture and furnishings in an historic building will vary enormously. Some historic buildings are magnificently furnished in their original style and contain priceless works of art, while others contain little in the way of furnishings. In the past, furnishings were made from natural materials such as cotton, wool, wood, felt, horsehair and canvas. These materials can be difficult to ignite and burn less briskly than synthetics.

Most historic houses will, of course, probably contain some modern furniture and fittings as well. A great deal of modern upholstered furniture contains polyurethane foam. Standard polyurethane foam furniture is readily ignited by a lighted match and burns fiercely, producing large quantities of dense, toxic smoke.

From November 1988 the use of standard polyurethane foam in new furniture sold for domestic use was banned and only combustion-modified foam permitted. However, while this type of foam is more difficult to ignite, it will still burn freely with the emission of dense, toxic smoke once alight.

Escape routes should not contain furniture but where this is unavoidable it should be of the type containing the fire-resistant foam.

Plant Rooms and Machinery Spaces

Boiler plant, electricity equipment switchrooms and gas meter rooms should only be used to store limited quantities of non-combustible spares and should never be used as general storage areas.

Historic industrial buildings may contain operational or non-operational machinery and equipment which represents an important and sometimes integral part of the structure and historic fabric. Protection of these elements should therefore be included in any fire protection scheme. However, working machinery may introduce additional risks, particularly if it is not regularly inspected and, if appropriate, stripped down. If dust is generated by the operation of the machinery this needs to be removed on a regular basis to prevent the build up of combustible material close to the machinery. There is also the risk of dust explosions.

Rubbish

Rubbish should not be allowed to accumulate in the building. Particular attention should be paid to areas such as boiler rooms, cellars, roof spaces and empty rooms.

All rubbish should be placed in metal bins with close-fitting metal lids, out of doors. This particularly applies to oil- or polish-soaked rags. (Such rags can be involved in spontaneous combustion.)

Rubbish should be disposed of without burning but if this is unavoidable a purpose-built incinerator must be used. Bonfires should only be used as a means of refuse disposal if sited at least 50m from any building.

Ashes and clinker from boilers should be damped down, placed in metal containers and removed each day to a safe place.

Ashes from coal and wood fires should be removed immediately from within a building, being carried in a closed, metal container.

Concealed spaces and roof cavities should be inspected regularly to remove combustible materials such as birds' nests, rubbish and builders' waste.

In no circumstances should aerosols, empty solvent containers or empty gas cylinders be disposed of by burning.

Thatch

Straw or reed thatched roofs are found on many cottages, public houses and farm buildings. While the average thickness of thatch is from 300mm to 400mm, far greater thicknesses may be present on very old buildings.

Straw can be ignited by sparks from a chimney or bonfire or by the heat from faulty electric wiring, particularly in very dry weather.

Flame retardant treatments for thatch are available, but may have to be renewed annually to remain effective. The chemicals used may encourage decay.

Other precautions include:

- fitting spark arrestors to the chimney pots;
- separating the straw from the chimney stack with heavy gauge aluminium foil;
- using quick-release wire netting to hold the thatch in place, so that the netting can be removed quickly in an emergency in order to get at the smouldering straw;
- trap hatches (for the dwelling below) should be provided to allow easy access to the underside of thatching;
- fitting a simple sparge pipe (suitably concealed in the ridge) connected to an inlet at ground level to which the fire brigade may connect a pump;
- providing, in some cases, a degree of fire separation between thatch and building interior by under-drawing with fire-resisting board material. The visual impact of this approach may rule it out in some instances; and
- checking the condition of pointing etc. of old chimneys in the roof space, especially if it is proposed to bring an old chimney back into use, or fit a log-burning stove.

Further advice is available from the Society for the Protection of Ancient Buildings, the Department of the Environment and the Thatching Advisory Service.

Timber in Construction

Large amounts of timber have been used in the construction of many historic buildings.

Floors are nearly always constructed of timber and the cavities between floorboards and ceilings are occasionally packed with insulating material. In addition, parts of older structures may have been dried out by constant heating.

Timber is a readily combustible material, although solid wood beams generally cannot be ignited by small ignition sources. Once ignited by a larger ignition source, wood burns rapidly and can produce large quantities of smoke.

As timber chars it tends to form a layer of charcoal on the burnt surface. This layer will often partly insulate the unburnt material. Therefore large timber sections may possibly continue to carry their load even when badly charred.

Even a fairly large timber baulk can be ignited by a small ignition source when the surface has been made friable by decay or insect attack.

Wood Treatments

The combustibility of timber is often temporarily increased by the need to treat wood to protect it from rot and infestation. While such treatment can be carried out using water-based solvents, many of the other liquids used are often highly flammable.

Any source of ignition should be removed from the area and care should be taken when spraying in the vicinity of electrical junction boxes. Timber treated in this way gives off a vapour which is highly susceptible to fire for about a week after the application. Adequate ventilation of any treated area is therefore required until drying is completed. Particular attention should be paid to the adequate ventilation of voids and all normal precautions and inspections increased during this period, and immediately after the work has been completed.

In August 1993, an Essex man died from burn injuries received after the ignition of flammable vapours produced when spraying timber in an attic.

7. Management policies for fire safety

It is often thought that once a building has been provided with an acceptable standard of fire precautions there is no further need to do anything else to ensure fire safety. This is a serious misapprehension - the effectiveness of fire safety provisions, particularly in historic buildings, is totally dependent on continuing management action.

For fire safety arrangements to be wholly effective there must be wholehearted commitment by management who must work to laid down policies. (See also Chapter 8, Policy Manual.)

Responsibility

In the case of a small privately owned house, the person in charge of such measures will probably be the owner or occupier. In a building occupied or visited by a larger number of people, the responsibility should be vested in a Fire Safety Manager, who is likely to be a senior person within the agency managing or owning the building. As this person will almost certainly have other duties, it is recommended that he be assisted by a Fire Safety

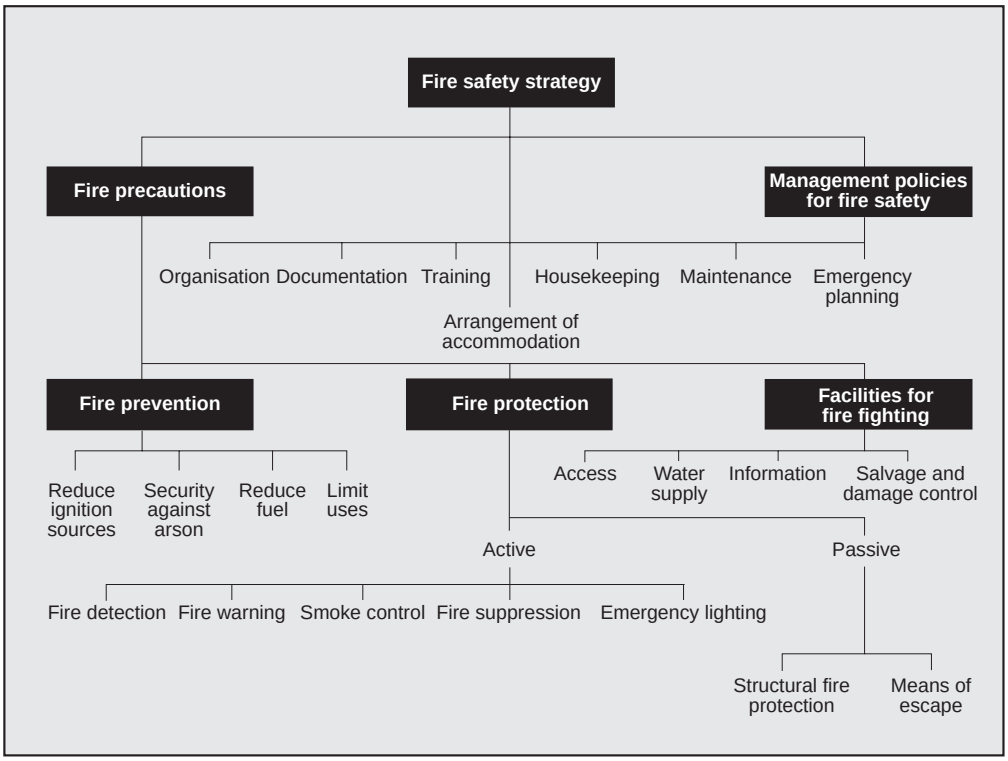


Figure 7.1. Components of fire safety strategy

Officer in respect of the day-to-day activity.

It may be appropriate in larger complexes to set up a Fire Safety Committee, attended by the Fire Safety Manager, Fire Safety Officer, Health and Safety Officer, Buildings or Engineering Manager, Estates Manager, Security Officer or other specialists at similar level.

Principles of Fire Safety

The primary objective of fire safety in historic buildings is to prevent fire occurring and the way this is to be accomplished can be summarised as follows:

- to safeguard life;
- to minimise damage to the fabric of the building;
- to protect the contents.

Fire safety is the joint responsibility of building owners, occupiers, management and staff. All concerned must be aware of their individual duties in ensuring that adequate standards of fire safety and property protection are both provided and maintained.

In practical terms, the provision of fire safety involves a combination of the components shown in Figure 7.1, the precise "recipe" depending upon the construction, layout and location of the building and the use to which it is put. The measures each contribute to the attainment of the total fire safety objective; they should not be considered in isolation but as an interactive system, possibly compensation in some parts for apparent "deficiencies" in other areas such as where the intrusion of visible fire protective measures might not be acceptable from an aesthetic or historical point of view.

The importance of properly defined management policies and procedures for fire safety in historic buildings of all types cannot be overemphasised.

Wherever practicable, smoking should be actively prohibited in historic buildings.

Duties of the Fire Safety Manager

The Fire Safety Manager (with any deputy or assistant appointed) should lay down clear written fire safety procedures and suitable staff should be appointed and trained in order to carry out those procedures. Training of staff is a primary function. Staff may be allocated duties such as calling the fire brigade, fire fighting, salvage work, supervision of the evacuation of visitors, meeting and assisting the fire brigade, security patrolling and monitoring of automatic fire detection and security systems.

The Fire Safety Manager should ensure that the arrangements he or she has made comply with the legal requirements for the use to which the building is put and with the recommendation of any insurers.

He should be aware of the various sources of advice available to him, including:

- local fire authority;
- specialist surveyors and in particular the expertise available from the RICS;
- insurance company or broker;
- local authority building control officer/environmental health officer;
- Clerk to the Licensing Justices;
- Crown Premises Inspection Group, HM Fire Service Inspectorate (if appropriate);
- The Fire Protection Association/ Loss Prevention Council;
- The Arson Prevention Bureau.

The Fire Safety Manager should, through the Fire Safety Officer where nominated, provide staff with guidance on the prevention of fire, for example, good housekeeping, refuse disposal, storage of combustible materials, use of equipment, and so on. This information should be provided in writing and covered during training sessions.

Other duties include:

- to prepare a written plan of procedures to be adopted in the event of fire, in liaison with the fire brigade;
- to train staff to ensure that they are aware of these responsibilities and the actions to be taken in the event of a fire, including how to use portable fire-fighting equipment. Records of such staff training should be kept;
- to arrange for regular fire drills to be carried out, keeping records of the drills and identifying any problems which have arisen. (A further fire drill should be carried out as soon as practicable after a previous drill has revealed serious defects.) The local fire brigade should also be invited to attend for familiarisation purposes;
- to prepare documentation for use by the fire brigade in an emergency, including detailed plans of the site and each floor of the building showing access points, fire hydrants, open water supplies, fire safety systems and services layout, including positions of isolating switches and valves (a copy of this document should be held by the fire brigade and should be regularly updated). Operating manuals for fire safety systems should also be available;
- to devise special precautions to reduce the risk of fire during building and repair works and maintain an adequate level of fire safety when fire systems are shut down for maintenance (see hot work permit procedure, Chapter 5, Contractors);
- to undertake an initial inspection of the site in order to assess the risk of fire, and establish checklists in order to reduce the likelihood of a fire occurring and ensure that fire safety systems are correctly maintained and operational. A record should be kept of all such inspections and of the action taken to remedy deficiencies. Records are best kept in a dedicated log-book but other systems or methods of maintaining records should be considered (any record kept on computer should have a suitable backup); and
- to arrange for periodic, regular fire safety audits to be carried out to evaluate effectiveness of fire safety arrangements.

It is a responsibility of a member of senior management to ensure that these matters are being properly attended to and to record that suitable checks have been carried out. The staff should also be encouraged to bring any potential fire hazard to the attention of their supervisors. By this means all staff maintain a high standard of readiness.

It is advisable to maintain a photographic record of both the structure and the contents of any historic building so that repair/reconstitution may be readily facilitated. Master copies should be archived separately, preferably off-site. County records offices or other organisations may store this material.

Any proposed changes to buildings, layout or use should be approved by the Fire Safety Manager beforehand. This may involve consultation with the fire authority where a fire certificate exists for the premises concerned (Annex 3).

The Fire Safety Manager should maintain a list (in order of priority) of desired improvements/alterations to the premises. It is then possible if an opportunity occurs (for example, following weather damage to a roof) to introduce fire compartmentation.

8. Preparation of fire safety policy manual, fire instructions, staff training and fire drills

Fire Safety Policy

One of the most important recommendations of the Bailey inquiry is that there is a need for those in charge of the premises to have a clear statement of fire safety policy and effective mechanisms throughout the management structure for implementing the policy. The policy will be unique to the premises and take account of all activities. This is not simply a matter of amending an existing safety policy (required under the Health and Safety at Work etc. Act 1974) but rather a clear statement of the aims and objectives of the organisation in its determination to ensure that fire is treated as seriously as it warrants.

The allocation of management responsibility was described in Chapter 7.

Fire Instructions

Everyone working or living in the historic building has to understand what to do in the event of fire and must be supplied with written instructions. It should be ensured that these are understood. This will enable all to take prompt and effective action. Pocket versions of these instructions (Figure 8.1) are available from the Fire Protection Association.

Instructions should be clear and brief, but it should be appreciated that the action required may vary depending on whether a fire occurs during the day, at night or at the weekend.

Copies of these instructions should be posted at strategic points for reference in an emergency, for example reception, rest rooms etc.

The instructions must contain as a minimum the following information:

- the action to take on discovering a fire;
- how to raise the alarm and the procedures this sets in motion;
- the action to be taken upon hearing the fire alarm;

FIRE INSTRUCTIONS

IF YOU DISCOVER A FIRE

- **Operate the nearest fire alarm call point immediately.**
- **Attack the fire with a suitable extinguisher if it is safe to do so.**

IF THE FIRE ALARM SOUNDS

- **The fire brigade will be called by** _____
- **Leave the building immediately**
- **Do not stop to collect personal belongings**
- **Do not use a lift**
- **Close all doors behind you**
- **Report to the assembly point at**

_____

- **Do not re-enter the building until instructed to do so.**

TO CALL THE FIRE BRIGADE

- **Lift the receiver and dial** _____ **999**
- **Ask the operator for the fire brigade**
- **When the brigade answer, state that the fire is at**

_____

- **Do not replace the receiver until details have been repeated.**

Figure 8.1. Example of pocket card used in larger premises where an automatic fire alarm system is fitted.

- the procedures for alerting members of the public and visitors, including, where appropriate, directing them to fire exits;
- the arrangements for calling the fire brigade;
- the procedures for evacuating the occupants of the building to an assembly point at a place of safety;
- the location and, when appropriate, the use of fire fighting equipment;
- the location of escape routes, especially those not in regular use;
- how to open all escape doors, including the use of any emergency fastenings;
- the importance of keeping fire doors closed in order to prevent the spread of fire, heat and smoke;
- how to stop machines and processes and isolate power supplies where appropriate;
- the procedures for salvage and damage control.

Fire Safety Training

The Bailey inquiry noted that one of the main lessons of the 1992 Windsor Castle Fire was the need for "effective training of all staff in basic fire risk management and the actions to take in case of fire".

Such training is not only required under health and safety legislation† but should be viewed as an essential part of every employee's principal task.

Training records should be kept for all employees (and volunteers where appropriate). All staff named on the emergency plan as having a supervisory role in the event of fire should receive additional appropriate training. Such training could include procedures for the following:

- ensuring that the fire brigade have been called;
- informing everyone present of the nature of the fire emergency;
- checking that the staff and public are safely evacuated and that a roll call, if appropriate, has been made;
- liaising with fire brigade on arrival and confirming whether everyone is accounted for, and notifying them of the location of the fire and any special risks, for example, the location of hazardous substances;
- where necessary, making arrangements for fire brigade vehicles to enter the site.

Additional training in the use of fire-fighting equipment, evacuation of visitors and residents, salvage and damage control and supervisory duties should be provided as appropriate.

Fire Drills

In addition to receiving training, all staff and volunteers should take part in a fire drill at least once every 12 months so that they remain familiar with the evacuation procedure. More frequent drills should be considered in premises open to the public.

The date, time and area evacuated for the fire drill should be recorded in the premises' Fire Log or record-keeping book.

† Mandatory fire training is also specified in the Fire Precautions (Places of Work) Regulations. (See page 19.)

Staff must be trained to use fire-fighting equipment

Fire Safety Manual

The Bailey inquiry also recommended that a fire safety manual should be kept. This document should not only record the established policy for the site but also detail:

- a description of the buildings, including a full list of drawings;
- any specific legislation which affects the site;
- fire safety strategy and objectives;
- management policies;
- the approach to risk management and safety audits;
- the means of escape in case of fire and the way in which compartmentation has been achieved;
- the fire protection systems and equipment installed;
- matters concerned with fire brigade access and facilities;
- the utilities and building services arrangements;
- the plans which will come into effect in the event of a fire;
- the levels of staff training to be achieved.

See also Annex 8 which includes the full summary of the suggested contents of the fire safety manual developed for English Heritage.

9. Action in the event of fire

Action in the event of fire consists of:

- Notifying occupants of the existence of a fire with a minimum of delay. In small buildings this may depend on people. In larger buildings a "break glass" electrical fire alarm system may be required while in some cases an automatic fire detection system (preferably connected to a central alarm station) should be installed.
- Calling the fire brigade immediately. Employees should be prepared to advise the fire brigade of the exact location of the building and the fire, its approximate size and whether any persons are in danger.
- In larger historic buildings it may be the responsibility of a telephone switchboard operator or of a security officer to notify the fire brigade. The fire brigade should be informed of the correct name and address of the building and the nearest entrance to the scene of the fire (if there is more than one entrance to the grounds).

An alarm should also sound throughout the building warning staff and visitors of the fire. A public address system can provide a useful supplement to an alarm. On hearing the alarm all those without specific tasks should leave the building by the nearest escape route and make their way to a predetermined assembly point. Very large buildings or complexes may require two-stage alarm systems. (See Chapter 10.)

Staff should supervise the evacuation of all occupants, other than staff engaged in fire fighting or salvage. The closing of doors and windows should be part of the evacuation process. This will restrict the spread of smoke and fire.

At the assembly point, the senior or nominated person will check that every person in the building has been accounted for and confirm that all visitors have been escorted out. It is therefore essential to keep an up-to-date list of staff, including people on holiday and temporarily absent. Any persons not accounted for should be reported to the fire brigade. (Because of the difficulty of reconciling numbers of persons who have entered with numbers of persons who have left, the physical checking of all parts of a building is considered essential.)

Employees trained in fire fighting should be confident enough to attack the fire, if it is safe to do so, but fire fighters should be withdrawn if there is any possibility of their escape route being cut off. As they are withdrawn, the fire should be isolated as far as possible by the closing of door and windows.

If only one person is present then the fire must be reported before any attempt is made to fight it. Should there be at least two people near the fire, the person discovering it can try to fight it while a second person reports the fire.

When the local fire brigade arrive they will take over fire fighting but fire teams can continue to assist the brigade by supplying information, such as the exact location of the fire and the location of water supplies and assisting with salvage under the supervision of the fire brigade (see also chapter 11).

No one should be permitted to re-enter the building until the fire brigade officer-in-charge states that it is safe to do so or until the fire brigade has handed control of the site to some other authority.

10. Protection from fire

Means of Escape

It is essential that in the event of fire in a building the occupants should be able to leave the building by their own unaided efforts without being overcome by the effects of fire. In small private dwellings, that is to say those not exceeding two storeys, this can usually be achieved by using the normal means of exit, including staircases. Simple precautions, such as keeping the doors, particularly of ground floor rooms, closed at night can be most effective. The use of smoke detection systems can provide useful early warning of fire and the earlier a fire is detected, the more time will be available to escape from it.

Means of escape must be clear and available for use at all times

In larger buildings other measures may be necessary. In some cases the means of escape to be provided and the arrangements for ensuring that they can be used at all material times, may be formalised by legislation.

The normal method of providing means of escape includes ensuring that rooms and other parts of a building have sufficient exits to permit anyone present to leave rapidly if a fire occurs; providing routes to external exits (e.g. corridors or stairs) which are protected by walls of fire-resisting construction and fire-resisting self-closing doors. The internal arrangement of the building should be such that the distance to a protected route or final exit covered by any occupant (usually known as the travel distance) is limited. In appropriate cases these measures need to be supplemented by a fire warning system, automatic fire detection, signs indicating the location of exits and fire-fighting equipment and emergency lighting.

Conventional requirements for means of escape have evolved during the past 50 years and are prescriptive in nature. They are based on the following principles:

- limiting travel distances to places of safety;
- providing exits and/or stairs of adequate width and quantity;
- protecting escape routes, including stairs, with fire-resisting construction;
- providing a fire alarm system to give early warning of a fire.

Travel distances are normally based on risk - the greater the risk the shorter the travel distance. When more than one exit route is provided the distance people should travel to

reach a storey exit should not normally exceed 12-25m (maximum travel time 1 minute) in a high fire risk area, 18-45m (maximum travel time 3 minutes) in a normal fire risk area, and 45-60m (maximum travel time 5 minutes) in a low fire risk area. Escape routes are normally protected to a half-hour standard of fire resistance and should lead to a place of safety. In all buildings, regardless of size, adequate means of escape should be provided having regard to the use to which the building is being put and the number of persons likely to be present.

Where members of the public are admitted to the premises then ideally the number present at any time should be known precisely.

There should be arrangements to ensure that the maximum number of people that can be safely accommodated is not exceeded, i.e. no more than the means of escape can cater for. (In the case of premises subject to a fire certificate, this number may be specified in the fire certificate.)

This conventional passive approach to fire safety has proved very effective in enabling the occupants of buildings to escape safely in the event of a fire. However, it places very little reliance on other fire protection measures, such as smoke detection, and in historic buildings may involve upgrading the fire resistance of constructional elements.

People with Disabilities

Consideration must be given to means of escape for those who suffer from physical or mental disabilities. British Standard 5588: Part 8: *Code of Practice for means of escape for disabled people* gives specific advice on means of escape for the disabled.

Except in the case of small private dwellings, these matters require careful consideration and managers in any doubt should seek specialist advice.

The Building Regulations

Although the Building Regulations (which apply to England and Wales) relate to new construction (or to premises undergoing renovation or change) it is worthwhile mentioning the various parts of the Department of the Environment's Approved Document B (which relates to fire safety matters). This document provides guidance on how the fire safety requirements of the Building Regulations may be met; it is in five parts:

B1 Means of escape

B2 Internal fire spread (linings)

B3 Internal fire spread (structure)

B4 External fire spread

B5 Access and facilities for the fire service

Scotland has legislation covering the same areas but it is very different in content and coverage.

Fire Safety Engineering Approach

In some situations it may be possible to adopt an alternative approach as described in English Heritage's forthcoming publication *The Fire Engineering Approach to Fire Safety in Historic Buildings.* This approach places more emphasis on the early detection of fires so that the occupants can be evacuated at the earliest possible opportunity, thereby permitting the conventional period of fire resistance to be reduced. This does not imply a lowering of safety standards but achieving a comparable standard by an alternative approach which provides a balance between the time it would take the occupants to escape

and the level of protection necessary to ensure that the escape routes remain safe for that period of time.

The fundamental principle of the fire safety engineering approach is the estimation of the evacuation time for the building. Estimates can be compared with known evacuation times for similar buildings or from fire drills carried out at the particular building. Predictions of evacuation time should always be treated with some caution as there will always be a degree of uncertainty about their accuracy and a factor of safety has to be included if this estimated evacuation time is to be used as the basis for determining the required level of fire protection to escape routes.

Fire exit sign in a Grade II listed building

Because of the uncertainties in predicting the reaction time of the occupants to the fire alarm it is unlikely that the fire safety engineering approach would justify any reduced standards of fire protection in buildings where people sleep. However, in buildings used for public assembly purposes, shops and offices, a reduction in the normal standards of fire protection (and other conventional fire safety measures) may well be possible, particularly if the alarm system is supported by a public address system or if an automatic fire-fighting system is installed.

If it is proposed to adopt a fire safety engineering approach the case needs to be prepared by a suitably qualified fire safety engineer with the full support of the building occupier/ user. It needs then to be discussed with the relevant statutory authority (for example, the building control officer or the fire authority) before any action is taken. Such an approach can also usefully be discussed with insurers at an appropriate stage.

In certain cases it may be possible to argue for a reduction in standards of fire protection where an early detection system is installed, i.e. ornate doors or structures of a construction in character with the building could be allowed a lower period of fire resistance, providing the doors or structures are well constructed and incorporate a high standard of smoke seal.

Sprinkler systems might also allow for this provision of reduction in standards of fire protection.

It must be remembered, however, that all alterations affecting listed buildings require Listed Building Consent (see Chapter 4) and if in the last resort this cannot be obtained because of the potential detrimental effect on the building, it may be necessary for owners/ occupiers to consider finding alternative uses and/or reducing the numbers of people using them.

Exit Signs

There is a duty to warn members of the public and others who may be unfamiliar with the layout of the premises, with the action to be taken in the event of fire and with the exit routes to safety. BS 5499 provides relevant information but the aesthetic demands of the

premises may call for some departure from the norm in listed and historic buildings. The general appearance in such cases should be agreed with the local planning authority and, where applicable, the local fire authority. It is recognised that there may be areas where the escape routes cannot be indicated in the normal way because of the effect this would have on the historic fabric and in these locations the presence of additional trained custodial staff can compensate.

Fire Alarm Systems

Equipment should be installed so that occupants are given early warning when a fire occurs. In all but the smallest premises, the alarm should be automatically transmitted to the fire brigade.

It is preferable that an electrically operated fire alarm should be provided incorporating, as an absolute minimum, manually operated (break glass) call points.

Electrical fire alarms should conform to BS 5839: Part 1: *Code of practice for system design, installation and servicing* (of fire detection and alarm systems).

The alarm must be capable of alerting all occupants (including those with hearing difficulties) in all parts of the premises. The installation of bells and other sounders should be done with sensitivity so as not to affect the special visual interest of historic buildings.

Call points and the control panels of fire alarm systems must be accessible at all times but can be carefully sited to avoid adversely affecting the character of the building. A public address system can usefully form part of the alarm system in extensive premises.

Fire Detection Systems

In larger buildings, and in particular those with residential accommodation, an automatic fire detection and alarm system conforming to British Standard 5839 should be installed. As there are many different systems, careful consideration should be given to their appropriateness, effectiveness and appearance.

An automatic fire detection system consists of sensors, which detect smoke, heat or flames, connected to a control and indicating panel. A panel lights up to show which zone (or which building) is affected by fire and a bell or other sounder operates. The alarm can be automatically transmitted via a commercial central alarm station or in some cases direct to the local fire brigade. This is an important feature but essential in the case of larger houses in rural areas where fire brigade attendance time can be long. All types of sensors can be installed relatively unobtrusively and it is possible, given an experienced designer, to install a fire detection system without undue disruption or visual intrusion. A comparatively new development has been that of radio-linked fire sensors and fire alarm call points which avoids the use of unsightly wiring or the need to open up fine

Beam detection system in a Grade II listed building

walls or remove panelling. (See Clause 18 of BS 5839: Part 1.) Radio-linked systems can be very effective when combined with optical beam fire sensors which can provide coverage over a wide area. In addition, it is possible to utilise a very small bore tube which aspirates the air and is connected to a remote smoke sensing unit. The tip of the tube (which can be less than 3mm in diameter) can be concealed in ceiling mouldings or other decorative features.

Proper maintenance and good staff training should minimise false alarms. All organisations should ensure that a procedure is established to deal with unwanted alarms and these should be recorded for future analysis. A testing procedure and schedule should be agreed.

In certain circumstances where there is a high incidence of unwanted alarms which cannot be reduced by other measures, it may be desirable to delay the automatic transmission of an alarm to the fire brigade, during 'public' hours, for a sufficient time to allow the alarm to be investigated. For this purpose the incorporation of a *transmission signal unit* may be considered (BS5839: Part 1 Section 14.7). However, such a delay must not affect the immediate evacuation of the building. The use of such systems should be agreed with the fire authority.

The need to control false alarms should not be overlooked and to this end reference is made to two Loss Prevention Council Standards which have been drawn up in consultation with manufacturers of fire detection and alarm systems and the fire brigades.

LPS 1014 *Requirements for certification of fire detection and alarm system firms*

LPS 1020 *Requirements for remote centres for fire alarm systems*

Compliance with these standards should be specified for new systems.

Public Address and Voice Alarm Systems

Experience in fires in public places suggests that people do not respond particularly well to bells and some kinds of electrical sounders. The best response is undoubtedly to a warning being given by the human voice. It is therefore good practice, where possible, to supplement alarm systems with public address systems. This is likely to be particularly appropriate in larger buildings where such a system can be used for other forms of security alerting.

Public address messages should be clear and suitable texts should be prepared in advance. Messages in different languages should be available as appropriate.

Recent advances in technology obviates the need for a member of staff to stand by a microphone for the duration of an emergency. Voice messages can now be stored on microchips and the passing of appropriate messages to different parts of a building can be initiated automatically.

Such systems, sometimes known as Emergency Voice Evacuation Systems (EVES) are now in use in a wide range of buildings such as large hotels, department stores, airport terminals and public attractions. Because of the life safety implications that the failure of such a system might cause it is essential that the design and installation of this equipment should be carried out by a reputable contractor. In the UK such companies belong to the Sound and Communications Industries Federation.

Addressable Detection Systems

Another fairly recent innovation in fire detection and alarm technology is that of the addressable detection system. This is based around the concept of the smart detection device. Rather than a smoke or heat detector simply being a switch (either 'on' or 'off'),

each sensor is a complete fire detection and control system in its own right. Thus not only is the sensor continuously monitoring itself for faults but when a fire or fault does occur an informative signal can be sent to the control and display panel. This signal will indicate the exact location of the sensor and the nature of the situation.

It is therefore now possible to programme such systems with a wide range of responses to various stimuli. For example in the case of a smoke detector it would be possible to set a threshold below which the sensor will not pass messages to the panel, thus ignoring the effects of cigarette smoke or toast making. In the case of a more intense level of smoke the response could be alerting security staff by a pager while a third level could be calling the fire brigade and initiating an evacuation of the premises.

Addressable systems can therefore provide not only a means for reducing the level of false alarms but also provide a more flexible and coordinated response to an emergency.

While such system components tend to be more costly than conventional fire detection systems there can be savings in the cost of installation as a loop system of cabling is normally adopted.

It is essential that those manning the Control Room or those monitoring the fire alarm controls are fully conversant with the equipment and procedures to be followed should a fire occur.

Portable Fire Extinguishers

The value of fire extinguishers should neither be underestimated nor ignored; fire extinguishers regularly account for a high percentage of all fires which are extinguished before the arrival of the fire brigade or to which fire brigades are not called.

Portable extinguishers are designed to enable a fire to be tackled quickly and easily in its very early stages. Extinguishers should comply with BS 5423: *Specification for portable fire extinguishers.* It is advisable to purchase equipment that carries either the BSI Kitemark or has the British Approvals for Fire Equipment (BAFE) or the LPC mark.

It is essential that an adequate number of approved portable fire extinguishers should be provided in historic buildings. The scale of provision of extinguishers is determined by the floor area and the risk to be protected in accordance with BS 5306: Part 3: *Code of practice for selection, installation and maintenance of portable fire extinguishers.*

An adequate number of portable fire extinguishers should be provided

As a minimum, at least one 9 litre water extinguisher or equivalent should be provided near to a doorway opening on to a staircase, or on a staircase landing, for every 200m^2 of floor space, with a minimum of two such extinguishers to each floor. Other types of extinguishers which have an adequate rating may be substituted for water extinguishers (see Figure 10.1).

BS 5306 uses the test performance ratings achieved by extinguishers under conditions specified in BS 5423. Extinguishers so tested are marked with a number reflecting the size of fire the extinguisher can be expected to

EXTINGUISHERS TO SUIT THE FIRE			
Extinguisher type	**The risk**	**Typical extinguisher sizes and ratings**	
Water *colour code - red*	Class A risk, solids wood, paper, cloth. For general protection of ordinary combustible materials. Do not use on live electrical equipment	9L 6L	13A 8A
Foam *colour code - cream*	Class B risk, liquids, fats, paint and oil. Some foam extinguishers such as AFFF are also suitable for combustible solids fires (Class A)	9L 6L	13A:183B 13A:144B
Dry powder (multi-purpose) *colour code - blue*	Class A risk, solids, wood, paper, cloth. Class B risk, liquids, fats, paint, oil and electrical equipment	10kg 6kg 4.5kg 2kg 1kg	34A:233B 21A:183B 21A:144B 5A:34B 3A:34B
Carbon dioxide [a] *colour code - black*	Class B risk, liquids, fats, paint, oil and electrical equipment	5kg 2kg	34B 21B
Halon [a/b/c] *colour code - green*	Class B risk, liquids, fats, paint, oil and electrical equipment also suitable for small surface-burning fires in combustible solids (Class A)	1.5kg 3kg	3A:34B 5A:55B

a. Gases which may be produced by the fire and the use of halon or carbon dioxide may cause eye irritation and breathing difficulties if a person is in an enclosed space with restricted ventilation.

b. Because of its ozone depleting potential the production of halon ceased on 1 January 1994 and only banked or recycled halon is now available. Existing halon extinguishers may continue to be used but halon will eventually become more difficult to obtain and fire safety managers should consider how any halon extinguishers will be replaced.

c. The Department of Trade and Industry has produced a new leaflet, *Fire Fighting Halons Phase Out: Advice on Alternatives and Guidelines for Users,* which may be obtained free of charge from: DTI, 151 Buckingham Palace Road, London SW1 9SS (Telephone: 0171 215 1018). See also Figure 10.2.

Figure 10.1

extinguish successfully. An accompanying suffix indicates whether this is for solid materials (class A) or flammable liquids (class B). Some extinguishers have both A and B ratings showing that they are suitable for use on both types of fires.

Other types of portable fire extinguishers may be required for special risks, for example to protect items of electrical equipment, for which carbon dioxide extinguishers should be provided close by. The fire rating of such extinguishers can be included when calculating the total of class A and/or B extinguishers provided.

The extinguishers should be normally located in conspicuous positions on brackets or stands where they can be rapidly seen by persons following escape routes. Extinguishers may also be located inside cupboards or in recesses provided that staff are familiar with these locations and provided that it is immediately obvious if the unit has been moved or tampered with.

The carrying handle of larger, heavier extinguishers should be 1m from the floor. Smaller, lighter extinguishers should be mounted so that the handle is 1.5m from the floor. Positions near to room exits, in corridors, stairways and lobbies are most suitable. It should never be necessary to travel more than 30 m from the site of the fire to reach an extinguisher.

Maintenance of extinguishers should only be entrusted to a company which is a member of a recognised trade association.

HALON PROTECTION FOR HERITAGE PROPERTIES

One of the questions that conservation specialists and curators most frequently ask the Fire Protection Association concerns the use of halon gases in fire protection systems.

The Montreal Protocol of 1987 - to which the UK is a signatory - pledges the phasing out of all gases which have a potential to deplete the Earth's ozone layer. These gases, which mainly consist of chlorofluorocarbons (CFCs), have been extensively used in industry in refrigeration and air-conditioning systems, as blowing agents for polystyrene foams and as fire-fighting foams.

The two main fire-fighting gases are BCF (Bromochlorodifluoromethane, also known as Halon 1211) and BTM (Bromotrifluoromethane, often called Halon 1301).

BCF is used extensively in portable fire extinguishers (usually coloured green), while BTM is found in fixed fire-fighting systems used to flood vulnerable areas such as computer suites and switchrooms.

The production of CFCs and fire-fighting gases is to be phased out and it is likely that pressure will be put on the UK government to advance the phase-out date. This means that existing stocks of the gases will have to be recycled if organisations want to continue using them.

There is no totally acceptable direct replacement for BCF and BTM. While a number of claims have been made, caution should be exercised in the purchase of any such system at the present time. The Department of the Environment has indicated that continuing use of halons will become expensive and subject to stricter controls.

The FPA suggests that the following policy should be adopted as being the most environmentally sound, while still permitting the best choice of fire protection to be maintained.

- Immediately stop discharging BCF extinguishers for training purposes.
- Never discharge fixed systems unless there is actually a fire.
- Leave existing fixed systems and extinguishers *in situ* until they need to be discharged for cylinder testing. Let a competent agent undertake this work to ensure that all the gas is recovered.
- If fixed or portable equipment becomes surplus to requirements, return it to the supplier for recycling.
- If a new facility is considered to be in need of protection either by BCF or BTM, apply the essential use test - is there any alternative way of providing fire protection without using halons?
- Consider the possible use of carbon dioxide flooding systems, other gas systems, water spray or sprinkler systems, or dry powder systems. If none of these prove suitable, and the items or area in question cannot be protected in any other way or because of life safety factors, then halon may be acceptable as a suitable agent.

In the unlikely event that the EC and UK decide to invoke a total ban on the use of halons for fire fighting, it is likely that there will be 2 or 3 years' notice of this decision, allowing time for alternatives to be purchased.

Figure 10.2

Fixed Hose Reels

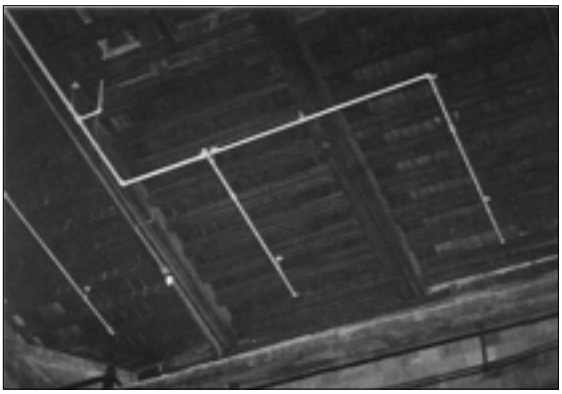
As an alternative (or supplement) to portable extinguishers, and provided there is adequate water pressure within the building, hose reels can be installed in accordance with BS 5306: Part 1: *Hydrant systems, hose reels and foam inlets* and BS 5274: *Specification for fire hose reels (water) for fixed installations.*

They should be sited in all but the smallest buildings so that a hose reel nozzle may reach to within 6m of any part of the protected building, the hose reel jet throwing the other 6m to reach the fire. Should such provision present a problem the first consideration should be given to the interest of the building.

When the nature of the structure permits, hose reels can be installed in a fashion which will not detract from the building's appearance, in staircases or lobbies where they can be boxed-in or otherwise concealed. Hose reels should be serviced in accordance with BS 5306: Part 1, see above.

Automatic Sprinkler Systems

Where a building and its contents are particularly valuable the installation of a fixed automatic sprinkler system should be considered in order to give added protection. It has been suggested that sprinklers are particularly suitable in cases where buildings contain extensive collections of art and furnishings and which are classified as being in "D risk" standards of fire cover, where the initial attendance by the fire brigade may take up to 20 minutes, or even longer in remote areas.



Sprinklers in the roof of Worcester Cathedral

Sprinklers provide efficient, reliable and economic protection and embody their own fire detection system. Many owners of historic buildings feel that despite these advantages it might not be practical to install sprinkler systems. This is because of the concern for structural damage and intrusion to the fabric of the building (caused by installation of pipework). There have also been fears that water damage caused by accidental discharge could affect the fabric or contents. The use of modern materials, miniature "fast response" sprinkler heads and pre-action systems (requiring a smoke sensor and a sprinkler head to actuate before any water is discharged) together with careful design can often overcome these concerns. In addition, the availability of modern materials such as plastic pipework make retro-fitting of sprinklers speedier, simpler, less costly and potentially less intrusive.

The impact of sprinkler heads and pipes will always depend on local, particular circumstances. For example, some robust buildings and many basements and roof voids can accommodate sprinklers both visually and physically far more easily than can the fine rooms on the *piano nobile* of an Adam house.

Statistics collected over the past century prove that sprinkler leakage is an insignificant risk and this is confirmed by the low cost of sprinkler leakage insurance premiums.

However, despite the undoubted value of sprinkler systems their effect, if activated, on timber panelling, priceless furniture, works of art etc., must be considered together with the long-term effect of water trapped in unventilated areas like floors and other voids. This means that before a system is installed the balance of alternatives must be carefully weighed. It may be that installing a sprinkler system would provide adequate levels of fire protection in a situation where other types of upgraded fire safety would involve an unacceptable level of impact on a building.

There is a concealed sprinkler head in the ceiling of this Grade II listed building

Care should also be taken to ensure that at least one source of water supply for sprinkler systems is independent of the water supply which the fire brigade may need for fire-fighting operations

It is essential that the system is correctly designed and properly maintained in accordance with BS 5306: Part 2 and LPC Technical Bulletins, or other national standards.

Insurers offer substantial discounts on fire insurance if sprinklers are installed and to ensure that only highly reliable systems are installed they liaise closely with the members of the British Automatic Sprinkler Association. The Loss Prevention Council tests and approves sprinkler equipment and issues lists of both installers and system components which meet its standards. Early contact with insurers is essential if their approval is to be sought.

Other Automatic Protection Systems

While sprinklers are the most common type of automatic fire fighting equipment there are a range of other systems which may be of value in certain circumstances.

Gaseous Systems

Fire protections systems utilising a gas have been in use since the 1930s. The most common application for this type of equipment is in the protection of electrical or electronic equipment. A wide range of gases can be used but the most common are:

Type of gas	Comments
Carbon dioxide	Can only be used in unoccupied areas
Halon 1211/BCF	Subject to phase-out as it is a CFC
Halon 1301/BTM	Subject to phase-out as it is a CFC
FM200	Developed as a replacement for BTM
Inergen	Mixture of CO_2, nitrogen and inert gases - replacement for BTM

Figure 10.3 Fire extinguishing gases

Gas systems are suitable only for relatively small spaces owing to the volume of the gas needed and the area to be protected has to be relatively airtight. In the heritage context, a gas system might be appropriate for the protection of a vault or similar storage area, especially where the material stored would be vulnerable to water damage.

Water mist systems

Mist systems were developed as a non-gaseous replacement for BTM and are effectively high pressure sprinkler systems where the water is supplied under very high pressure. The pressure and droplet size means that the optimum heat absorption conditions are created and, in a confined space, quite a large fire can be extinguished with very little water.

No such equipment is yet certified for use in the UK but it is understood that London Underground has utilised this type of equipment to protect electrical switchgear.

One US company is understood to be installing this type of equipment in a university library. There would appear to be a number of significant attractions to this kind of equipment in the heritage context; these may include:

- minimal use of water
- ability to use smaller bore piping
- head placement is less critical than in conventional sprinkler systems

On the other side of the equation it is likely that the system will be more expensive than sprinklers and could be prone to accidental actuation as some sort of heat, smoke or flame detection system will be needed to ensure rapid actuation.

Recent full-scale tests on the mock-up of a wooden church in Norway have produced very encouraging results.

Foam systems

There are two principal types of foam system: high expansion and medium expansion. Medium expansion systems are normally used to protect large-scale storage of petrochemicals and flammable liquids. High expansion foam has been used for the protection of cable tunnels and similar locations and may have an application in underground areas and basements of historic buildings.

In both cases the foam is manufactured by aspirating a solution of foam compound and water through special equipment. As the foam contains water the usual *caveats* about water damage apply.

Foam can also be used in fixed systems protecting kitchen ranges.

Dry powder systems

There are a number of chemical powders which have good fire extinguishing properties. The most popular of these is mono-ammonium triphosphate (MATP) which is frequently used in portable fire extinguishers.

Powder is most effective when used against fires in flammable liquids but care has to be exercised that re-ignition does not occur after the fire has been 'knocked down'.

The most likely use of an automatic extinguishing system using powder is to protect the range and hood of a large kitchen. Actuation of such systems is usually by a fusible link which melts at a fixed temperature. The powder is then propelled by gas pressure (usually nitrogen) from its cylinder through discharge nozzles set above the range and in the grease filter area of the hood.

While powder is effective against all kinds of fires and is safe to use in fires involving live electricity it is not as effective as water in extinguishing fires in normal combustibles (such as wood, paper, plastic and textiles). It is also ineffective against deep seated fires. Powder's major disadvantage is the mess it causes. It also has the disadvantage that it often bakes onto hot surfaces and can cause permanent damage to books, parchments, paintings and photographs as well as destroying the printed circuit boards inside electronic equipment.

Emergency Lighting - Exit Routes

In those historic buildings that are used as places of work, hotels, conferences etc., or are open to the public, emergency lighting should be provided to ensure that people can escape from the building in the event of the normal lights failing. The emergency lighting should illuminate corridors, stairways, fire-fighting equipment and notices identifying exits and escape routes. The system should be independent of the normal electrical supply and operate automatically when the normal lighting circuits fail.

Emergency lighting may either be powered from a central battery supply or consist of self-contained units. However, whichever arrangement is chosen, the testing and maintenance schedules indicated in BS 5266: Part 1: *Code of Practice for emergency lighting,* should be complied with.

In some circumstances, fire authorities and licensing authorities may also permit the use of photoluminescent materials which do not require an electrical supply as an alternative to fire escape signs and where ornate ceilings and wall hangings are present it may be attractive to secure agreement to light exit routes at low level. Careful choice and location of lighting is essential if historic spaces are not to be compromised.

Maintenance

The maintenance of all fire detection, control and extinguishing equipment is of paramount importance. The most cost-effective and reliable way to accomplish this is to enter into a service contract with the supplier, installer or other reputable company. When awarding a maintenance contract due regard should be paid to factors such as response time, reliability and local reputation.

Training

It is essential that all staff receive regular training in the use of portable fire equipment. Advice on the provision of such training which can be purchased from a wide range of sources is available from fire brigades or the FPA.

11. Fire-fighting, salvage and damage control

Access for the Fire Brigade

In the event of a fire, it is vitally important that there is suitable access for fire brigade appliances and equipment. In urban areas the existing situation will have to be accepted as it is, but the owner of the property should nevertheless liaise with the fire brigade on access routes and water supplies. In other cases, roads and footpaths on private property should be designed to provide adequate access for fire appliances. Detailed guidance on turning circles etc. is available from fire authorities. In case of new structures, provisions must be in accordance with the Building Regulations, Approved Document B, Part 5.[†] Requirements for historic buildings should where possible provide the following:

Gateways should be a minimum of 3.1m wide
Photo: Stewart Kidd

Roads of suitable material should be provided to within 45m of a suitable entrance to the building and depending on the size and height of the building, appliances may require additional access for rescue or fire-fighting purposes. Roads should not be less than 3.7m wide or, if they form part of a clearly marked one-way traffic system, 3m wide. Gateways should be a minimum of 3.1m wide and have a minimum height clearance of 3.7m or 4m if high-reach fire appliances could be deployed. Pumps require 16.8m as a turning circle and high reach appliances require 29.0m. Footpaths likely to be traversed by fire brigade personnel should not be less than 0.75m wide.

Roads should have no overhead cable less than 4.5m above the ground. Wherever practicable roads and footpaths should be suitably lit. Emergency vehicle routes within the grounds should be kept clear of obstruction at all times.

There must be adequate hard-standing areas adjacent to access points for water supplies. Roadways and hard-standing areas should be capable of supporting fire appliances which have minimum carrying capacities of 12.5 tonnes for pumping appliances and17 tonnes for high-reach appliances.

[†] Or provide an equivalent level of compliance.

The name of the historic building should be conspicuously displayed at all entry points from public roads. (It may not be a fire appliance from your "local" fire station which responds!)

If the historic building is unoccupied for part of the time then the owner should ensure that the police have a telephone contact number. This is essential if an intruder detection system is installed.

In rural areas the fire brigade may take 20 minutes to arrive after they have been summoned. Owners of historic buildings in these areas should be aware of this and plan accordingly. Where an automatic fire detection system is connected to the fire brigade the name and phone number of a keyholder should be provided.

Water Supplies

When summoned to a fire, the fire brigade will respond with a number of vehicles, including specialist appliances, and manpower, which their inspections indicate will be required for normal purposes. This response will, in the main, consist of appliances carrying 1800 litres of water, a high-capacity pump, hose reels and rolled hose, and breathing apparatus. The water carried by the tender is sufficient to extinguish the majority of small fires. For larger fires, fire fighters will need to use the fire hydrants forming part of the mains water supply.

Buildings in isolated rural areas will normally only have a mains water supply for domestic purposes, in this case the fire brigade will have to use bulk water carriers and hose-laying vehicles for relaying water. This will take time.

The preferred solution is for the installation of some form of tank (it is suggested that a minimum of 50,000 litres should be provided). Tanks should be clearly indicated and easily accessible. Swimming pools, ornamental lakes and ponds may be suitable for this purpose but prior assessment (as part of an agreed plan) should be undertaken.

If the mains water supply has sufficient pressure and flow then private hydrants can be installed (to the same standards as public hydrants). Excavations may effect sensitive archaeological remains which are often stautorily protected under Ancient Monument legislation. Underground hydrants should be clearly marked with a conventional plate.

If a top-up system (using electric pumps) is provided for the reserve supply, it is advisable to ensure that the electric supply is wired separately from the rest of the building to ensure continuity even if the building's supply has to be isolated.

Advice on these matters and, in particular, the amount of water likely to be needed for fire-fighting operations, should be obtained from the fire brigade and water authority as appropriate.

Planning to Reduce the Disruption caused by a Fire

The disruption caused by a fire and the time during which the building is out of use can be minimised by proper planning. In larger buildings, a contingency planning committee should be set up. Although prevention is better than cure, there will always be the possibility of a fire occurring, even in the best protected situations. The resultant damage and loss can be mitigated by adequate preplanning. However remote the possibility of a fire occurring may seem, the benefits of adequate preplanning cannot be overemphasised.

Any preplanning should be based on a fire risk assessment of the building to identify how, where and when incidents may occur. This will permit adequate planning to be

undertaken to ensure prevention of the event (if possible), mitigation and rapid restoration to normality. Nothing should be left to chance and the more detailed and thorough the preplanning, the greater the likelihood of minimising any subsequent loss and inconvenience. The risk of arson should also be considered (see chapter 12).

A photographic survey of the building and its contents will prove invaluable in the event of a fire. This may mean special photography, possibly photogrammetry from one of the numerous specialist surveying companies in the United Kingdom. Photographs, drawings and other records of the building should be kept either off-site or in a fire-resisting cabinet so that a record of what the building should look like is readily available. These photographs can then be used to good effect during rebuilding. It should be noted that copies of these photographs can be deposited with the National Building Record, Royal Commission on Historic Monuments or the Royal Institution of British Architects. This off-site storage will reduce the risk of a total loss in case of disaster and will secure restoration plans.

In cases where drawings showing the floor layout of historic buildings do exist the owner should arrange to make them available to the fire brigade as part of the preplanning arrangements. County records offices may also wish to receive copies of drawings or photographs.

The preplanning exercise should include the following:

- A detailed inventory of contents and important structural features (on a floor by floor basis) with a basic priority coding system, indicating the order for removal, ie first, second and third category. Any items of little consequence should not be categorised and should be left. Large items that cannot be removed and structural features should also be categorised, so that an order of salvage work for sheeting, ventilation, damming etc. can be determined.
- All such articles and features should be photographed and recorded on floor plans. One plan should be kept separate for references purposes, after the event. Copies should be made covering specific areas in which teams are to work. These should be encapsulated plans, indicating the priority for removal or salvage with any special instructions on dismantling and removal of items. Any keys required for access to the area or to display cases should be kept with the relevant plan and be readily available. The scope of the task should be properly assessed, in relation to the number of people and the equipment that will be required.

Lanhydrock House: staff practise removal techniques

- The number of people who will be available and the number who can be summoned quickly should be identified. These should be formed into teams assigned to one specific area of responsibility with a back-up role to a second area. The teams need to be familiar with the layout of the area and the priority of the items for removal and salvage. In the case of external resources such as contractors, it is strongly advised that a formal agreement in the form of a dormant contract be drawn up.
- The teams should undertake practical training and be involved in joint exercises with the local fire brigade. There must be a clearly laid-down procedure for immediately sounding the alarm and calling the fire brigade in the event of an incident and for calling any of the team members, 24 hours a day. Salvage team members should be provided with appropriate items of protective clothing which should incorporate some means of identification (for example, tabard, armband or markings on hard hats).
- Areas need to be identified for the temporary storage of items removed and any arrangements made in advance with contractors for the provision of service, such as specialist removal/storage or temporary on-site storage facilities. It should be ensured that the necessary equipment and tools for specialist personnel (conservators, surveyors and other professional advisers) are easily accessible at all times. In some areas, private specialist salvage firms are available. A selection of salvage equipment should be kept on the premises: heavy waterproof sheets for roof protection, shovels, ladders, ropes, brooms, hard hats, gloves, emergency lighting equipment, heavy-duty plastic sacks and plastic sheeting for protecting internal surfaces.
- A readily accessible list of the telephone numbers and addresses of all key services should be kept, including:

  Local authority departments

  Architect/surveyor/engineer

  Building contractors - plumbers, carpenters, electricians, heating engineers

  Experts in the care and recovery of historic items (conservation specialists)

  Smoke residue removal experts

  Utilities' emergency telephone numbers: electricity, gas, water

  Insurers/loss adjusters

  Plant hire contractors (for pumps, generators, heating equipment etc.).

Once a plan is formulated, ensure all involved in its execution receive initial training following by regular familiarisation training. The plan should be regularly reviewed, at least annually, and if and when there are changes to the premises, contents or staff which will affect the implementation of the plan. Any changes required should be made as soon as practicable, any plans and instructions amended as necessary and those responsible for carrying out the action duly informed and the appropriate training given.

Any preplanning will only be effective if it is kept up-to-date and those involved have received adequate training.

The personnel at any of the fire stations who will attend an incident should be invited to make regular familiarisation visits and consideration should be given to involving them in practical exercises. They will then become familiar with the access, water supplies,

Salvaged items should be moved to a place of safety immediately
Photo: Steve Osborne-Brown

building layout and items and features of special importance, which will enable them to maximise their efforts in the event of an incident.

For more information on involving the fire brigade see Annex 10, the Lanhydrock House case study.

After the Fire

Access to the site may be restricted by considerations of structural integrity or for the investigation of the cause of the fire. Indeed, the structural integrity of the building or its remains must be established as a first priority by specialist advisers and any stabilising measures carried out before access is allowed for any other purposes. It may be necessary to exercise control in respect of over-enthusiastic local authority personnel who may want to demolish parts of a fire damaged building. In such cases, advice from English Heritage or similar agencies may be helpful in tempering such actions. It should be remembered that dangerous structure legislation suggests alternatives to demolition when appropriate.

The debris should be searched for any valuable items. These should be labelled and the position in which they were found recorded.

A damaged roof should be covered with tarpaulins in order to minimise subsequent rainwater damage. Any temporary remedial work should be designed by a competent professional (surveyor, engineer etc) to ensure adequate fixture and structural stability is maintained.

Appropriate warning signs, barriers etc. should be erected. The FPA publishes a helpful guide to the criteria necessary to ensure safety in such conditions.[†]

[†] *Safety at scenes of fire and related incidents,* J. W. Munday, Fire Protection Association, 1994.

Windsor Castle after the fire: a de-humidifier is in operation

As far as possible, residual water should be removed using squeegees, cloths and suction equipment.

Drainage of fire-fighting water is especially important in cathedrals, churches and medieval buildings with masonry vaults. A Belgian cathedral nave vault collapsed some years ago under the weight of water collected on the upper side during a roof fire. All such vaults should have draining plugs in their lower parts. (Refer for advice to the Cathedrals Fabric Commission.)

Besides the physical force of pressurised water damaging friable materials, water will also put soluble materials into solution and literally begin to wash them away.

After the fire is doused, masonry structures will have absorbed huge quantities of moisture and several damaging processes then begin. In winter, freezing conditions can cause frost and saturated, soft masonry may crack and exfoliate. As the water dries out of materials it draws inherent and nearby ground water salts in solution to the surface where they crystallise, causing efflorescence, powdering and surface crumbling. Moulds and fungi are also encouraged and will flourish on timber and other organic material causing rot and decay so protection, insulation, ventilation and drainage are essential, particularly as winter approaches.

The building should be thoroughly dried (for example, by using dehumidifiers), but special care must be taken not to start another fire or to over-dry old buildings.

Specialist advice should be sought on damaged artifact conservation from the conservation unit of the Museums and Galleries Commission or from conservation specialists in the local area museum service. This should be done without delay as combustion products can be highly acidic and therefore very corrosive. As an emergency measure, certain valuable items (for example books but not photographs), can be freeze dried in commercial freezers (for example in abattoirs). This will arrest further damage until assistance can be obtained.

Consideration should be given to the need to plan for suitable, secure storage space for salvaged materials.

To remove the smoke odour it may be necessary to use a process in which a deodorising liquid is passed through electrically driven sprayers.

Used extinguishers should be recharged. Hose reels should be wiped clean and rewound.

Alarm systems should be reinstated.

Premises should be safeguarded against theft. Broken windows should be boarded up and broken doors should be repaired and padlocked.

Consideration should be given to the need for the premises to be guarded.

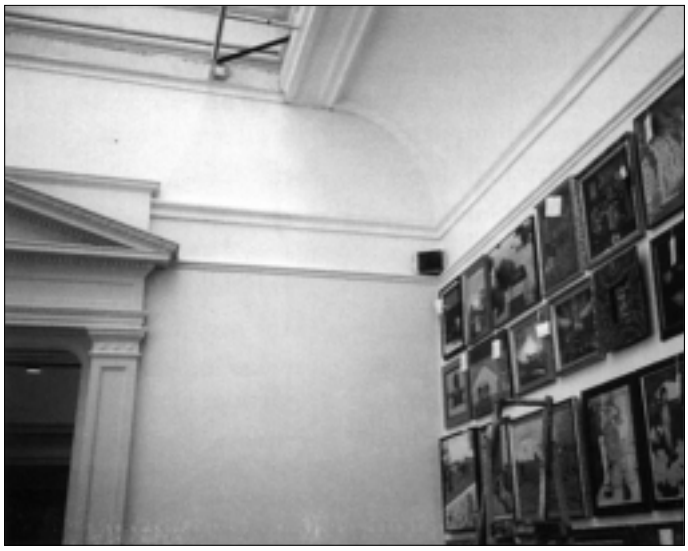
If fire or other structural damage makes it necessary to consider demolition of all or part of a listed building, special considerations apply.

1. If the building is listed, any works of demolition, in addition to alterations or extensions, must be the subject of an application for Listed Building Consent to the local planning authority (the Planning (Listed Buildings and Conservation Areas) Act 1990 contains a provision covering emergency works necessary in the interests of safety or health, or for the preservation of the building).
2. Planning permission may also be required for any works constituting development. This includes all construction work within the curtilage of a listed building (Town and Country Planning General Development Order 1988, Schedule 2, Part 1, Class A1(g)).
3. If the building, or any part of the land, is scheduled as an Ancient Monument, any work of excavation, alteration, demolition or repair will need express consent (Scheduled Monument Consent) from the Department of the Environment. (Ancient Monuments and Archaeological Areas Act 1979.)

In England and Wales advice on 1 and 2 can be obtained from the Planning Department of the local planning authority, that is, the district, metropolitan or London borough council or Development Corporation or National Park. For scheduled Ancient Monuments advice should be sought from English Heritage or appropriate agency.

Further information can be obtained in the FPA data sheet MR8, *Fire damage control - emergency planning.*

12. Security and arson



Pictures in this gallery are protected by an intrusion detector beam

All too often fires in historic buildings are begun deliberately by arsonists with "motives" ranging from mindless vandalism to attempts to cover crimes such as burglary. Arsonists are usually from outside but some deliberate fires are begun by a person within the building (possibly with a grudge or imagined grievance).

How should the owners or the management of historic buildings set about the prevention of arson? The measures they adopt will be taken as part of the general approach to the security as well as the overall fire safety plan for the buildings.

ACTION PLAN AGAINST ARSON

Assess the Risk of Attack

In any building there is no way that fire safety and security can be considered if the risks in their totality have not been taken fully into account.

Critically examine (possibly in collaboration with fire and police officers and insurers) the building and what goes on within it. Consider all the possible ways in which intruders could get into the building and weaknesses in the security arrangements. Consider to what extent visitors (and staff) have legitimate access to each part of the building and to what extent they are supervised or not. Consider the most sensitive (valuable) parts of the building (and contents) and the possible extent of loss. What are the most cost-effective remedies to put in place, both generally and to protect specific areas?

Draw Up a Plan

Based on the risk assessment exercise referred to above, draw up a plan to deal with all aspects of security vulnerability: the plan should specify not only potential weaknesses but also the methods to be adopted to minimise the risks.

Physical Security (See also Annex 11)

Bearing in mind the high incidence of arson and break-ins generally, the building needs to be made as secure as possible against intruders of all kinds.

Security measures begin with a routine to ensure that doors and windows are securely fastened at night, that entrances open to the public are kept to a minimum and are effectively supervised. Weak spots such as letter flaps and gaps under doors should be strengthened. Fences, walls and gates should be kept in good repair.

Existing wooden shutters behind windows and doors can be strengthened to increase resistance to intruders (see Annex 11). Secondary glazing units in steel or hardwood frames will provide greater strength. Steel bars across windows can be designed as an architectural feature. Doors can be protected by an internal steel shutter or replaced with high-grade laminated doors which are dressed with panels and beading to provide a suitable appearance. The design of steel bars or grilles across windows can follow historical precedent.

Further measures, dependent on risk, may include the installation of an intruder alarm system linked to a central station which will relay the call to the police, external security lighting and closed-circuit television cameras. For larger premises some or all of these measures will be required, as will access control arrangements at public points of entry. Security staff may need to be employed with patrols being undertaken when the building is closed. More details of these measures can be found in Annex 11.

Installation of Security Systems

The installation of an electronic intruder alarm or other type of system is a complex business and is made more so when the property to be protected consists of a listed building. Great care should be taken in selecting a contractor to undertake this work and, in all but the smallest premises, recourse should be made to independent expertise. The National Approval Council for Security Systems - a wholly independent certification body - can provide a list of approved companies installing all types of security systems. NACOSS can also provide general advice on standards of installation, maintenance and monitoring of such equipment.

Checks

It is absolutely vital that even in the smallest historic building a daily check should be made (usually last thing at the end of the day) that all is safe and secure, that doors and windows are locked, that any smouldering cigarette-end is extinguished, that electrical appliances are switched off. Such an inspection should be carried out by the owner in a small building or by a responsible person in larger premises.

Staff Vetting

Do not overlook the possibility that fires may be deliberately started by a member of staff. It is essential that proper pre-employment checks are carried out for all personnel (including part-timers and seasonal staff). Checks should include obtaining references from previous employers.

Security Advice

Advice on security can be obtained from police, insurers or the Loss Prevention Council. A list of supplementary sources can be found in Annex 1.

Investigation

Any fire however small, should be reported to the fire brigade and investigated by the owner/manager of the building. It is not unusual for a major arson fire to be preceded by one or more smaller attacks, or unexplained vandalism or break-ins.

13. Further Information

ANNEX 1: BIBLIOGRAPHY AND FURTHER READING

Fire Protection Association

The Fire Protection Association publishes a number of data sheets which will be of value to the readers of this book. Some Loss Prevention Council recommendations may also be of interest.

Publication ref.	Title
Arson	
AR 1	Management guide to fire investigation
AR 2	Prevention and control of arson in warehouse and storage buildings
AR 3	Prevention and control of arson in school buildings
AR 4	Incendiary devices: information and guidance
Management	
MR 2	Fire safety and security planning in industry and commerce
MR 5	Security against fire-raisers
MR 7	Procedure in event of fire
MR 8	Fire damage control: emergency planning
MR 10	Fire safety training
MR 11	Occupational fire brigades and fire teams: organisation, role and functions
MR 12	Fire safety and training of people at work
Nature of fire	
NB 1	The physics and chemistry of fire
NB 2	Ignition, growth and development of fire
NB 3	The physiological effects of fire
NB 4	The combustion process
Protection equipment	
PE 1	Automatic fire detection and alarm systems
PE 2	Fire points
PE 3	Fire blankets
PE 4	Portable fire extinguishers
PE 5	First-aid fire fighting: training
PE 6	Fixed fire extinguishing equipment: the choice of a system
PE 7	Fixed fire extinguishing equipment: hose reels
PE 8	Hydrant systems
PE 9	Automatic sprinklers: an introduction
Security	
SEC 0	Security organisations

SEC 1	Security equipment and systems
SEC 2	Site layout
SEC 3	Fences, gates and barriers
SEC 4	External security lighting
SEC 5	Closed circuit television (CCTV)
SEC 6	Doors
SEC 7	Windows and roof lights
SEC 8	Escape hardware
SEC 9	Locks
SEC 10	Hardware for fire and escape doors
SEC 11	Use of contract security personnel
SEC 12	Use of in-house security personnel
SEC 14	The secure building envelope
SEC 15	Guidance for the protection of premises against terrorist attack

General precautions

GP 2	Cutting and welding
GP 9	Fire dangers of smoking
GP 10	Waste incinerators
GP 14	Flame retardant treatment for textiles

Loss Prevention Council

ES 1	Electricity at Work Regulations 1989. Compliance for firms without electrical staff
RC 7	Recommendations for hot work
LPS 1014	Requirements for certification of fire detection and alarm system firms
LPS1020	Requirements for remote centres for fire alarm systems

Other FPA/LPC information

The Loss Prevention Council's Publications Catalogue contains many titles of interest, including:

Fire prevention on construction sites, Joint Code of Practice on the protection from fire of construction sites and buildings undergoing renovation, LPC/Building Employers Confederation/National Contractors' Group, 1994.

Code of practice for occupational fire brigades, Loss Prevention Council, 1992.

The fire protection of old buildings and historic town centres, FPA, 1992.

Planning company fire safety, FPA, 1993.

How to use a fire extinguisher (video), FPA, 1990.

Front line fire safety: the role of the fire warden (video), FPA, 1994.

The museum and record office emergency manual, East Midlands Museum Service/FPA, 1991.

Safety at scenes of fire and related incidents, FPA, 1994.

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Part 2. *Fire Protection Review*, vol.38, no.411, February 1975, 86,88.

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ANNEX 2

RELEVANT STANDARDS AND CODES OF PRACTICE

Heating Systems

BS 3248: 1986: (1991) Specification for sparkguards for use with solid fuel appliances
BS 6539: 1984: (1991) Specification for fireguards for use with solid fuel appliances
BS 6778: 1986: (1991) Specification for fireguards for use with portable, free-standing or wall-mounted heating appliances
BS 6798: 1987: Specification for installation of gas-fired hot water boilers of rated input not exceeding 60kW

Means of Escape

BS 6651: 1992: Code of practice for protection of structures against lightning.
BS 5588: Fire precautions in the design, construction and use of buildings
Part 1: 1990: Code of Practice for residential buildings
Section 1.1: 1984: Code of practice for single-family dwelling houses
Part 2: 1985: Code of practice for shops
Part 3: 1983: Code of practice for office buildings
Part 4: 1978: Code of practice for smoke control in protected escape routes using pressurisation
Part 6: 1991: Code of practice for places of assembly
Part 8: 1988: Code of practice for means of escape for disabled people
BS 5655: Lifts and service lifts Part 1: 1986: Safety rules for the construction and installation of electric lifts

Fire Protection Installations and Equipment

BS 5839: Fire detection and alarm systems for buildings
Part 1: 1988: Code of practice for system design, installation and servicing
Part 2: 1983: Specification for manual call points
Part 3: 1988: Specification for automatic release mechanisms for certain fire protection equipment.
Part 4 : 1988: Specification for control and indicating equipment
Part 5: 1988: Specification for optical beam smoke detectors
BS 5306: Fire extinguishing installations and equipment on premises
Part 1: 1976(1988): Hydrant systems, hose reels and foam inlets
Part 2: 1990: Specification for sprinkler systems
Part 3: 1985: Code of practice for selection, installation and maintenance of portable fire extinguishers
Part 4: 1986: Specification for carbon dioxide systems
Part 5: Halon systems
Section 5.1: 1992: Halon 1301 total flooding systems
Section 5.2: 1984: Halon 1211 total flooding systems
BS 5274:1985: Specification for fire hose reels (water) for fixed installations
BS 5423: 1987: Specification for portable fire extinguishers
BS 336: 1989: Specification for fire hose couplings and ancillary equipment (includes specification for hydrant standpipes)

BS 750: 1984: Specification for underground fire hydrants and surface box frames and covers

Emergency Lighting

BS 5266: Emergency lighting Part 1: 1988: Code of practice for the emergency lighting of premises other than cinemas and certain other specified premises used for entertainment.

Premises and Fire Certificates

Home Office/Scottish Office, *Code of Practice for fire precautions in factories, offices, shops and railway premises not required to have a fire certificate,* HMSO.

Home Office/Scottish Office, *Guide to fire precautions in existing places of work that require a fire certificate,* HMSO.

Home Office/Scottish Office, *Guide to fire precautions in existing places of entertainment and like premises,* HMSO.

Home Office/Scottish Office, *Guide to fire precautions in premises used as hotels and boarding houses which require a fire certificate,* HMSO.

The Building Regulations 1991

Department of the Environment, *The Building Regulations 1991: Approved Document B: Fire Safety,* HMSO, 1992.

B1 Means of escape

B1 Internal fire spread (linings)

B3 Internal fire spread (structure)

B4 External fire spread

B5 Access and facilities for the fire service

National Fire Protection Association (USA)

The NFPA publish a wide range of codes, standards and good practice documents. While not all of these are wholly relevant to UK practice and circumstances, there are four heritage-related documents which do provide guidance not readily available elsewhere. These are:

NFPA 910 Libraries and library collections;

NFPA 911 Museums and museum collections;

NFPA 912 Places of worship;

NFPA 914 Rehabilitation of historic structures.

The FPA Publications Department can supply copies of these documents.

ANNEX 3
EFFECTS OF THE FIRE PRECAUTIONS ACT 1971

Fire Certificates

Premises put to a use designated under this Act (currently the larger factories, offices, shops, railway premises and most hotels and boarding houses) are required to have a fire certificate unless they are exempt, in which case certain other basic duties apply.

Fire certificates are:

- required for premises used as factories, offices, shops or railway premises if they are not exempt from the requirement to have a certificate (see below);
- required for premises used as hotels or boarding houses which provide sleeping accommodation for more than six persons, being staff or guests, or provide sleeping accommodation above the first floor or below the ground floor;
- issued mainly by fire authorities, but for Crown Premises by HM Fire Service Inspectorate (Crown Premises).
- issued only after an inspection.

The fire certificate will specify:

- the particular use or uses of the premises which the certificate covers;
- the means of escape in case of fire;
- the means of ensuring that the escape routes can be used safely and effectively at all material times (this could include protection of lobbies, staircases etc, emergency lighting and directional signs);
- the means for fighting fire with which the premises are provided;
- the means for giving warning in case of fire;
- in the case of factories, details of any explosive or flammable liquids which may be stored or used in the premises.

In addition, the certificate may impose requirements for:

- how means of escape routes are to be maintained and kept free from obstruction;
- how other fire precautions specified are to be maintained;
- the training of those employed in the premises on action in the event of fire;
- record keeping of training and drills;
- limitations on the number of persons permitted on the premises at any one time;
- other relevant fire precautions to be observed.

Guidance may be sought from the *Guide to fire precautions in existing places of work that require a fire certificate,* HMSO.

Buildings or premises which are exempt from fire certificates:

- include factories (provided highly flammable materials are not stored or used), offices, shops and railway premises
  - in which not more than 20 people are at work at any one time and
  - in which not more than 10 persons are at work at any one time elsewhere than on the ground floor of the building;
- include certain low risk premises exempt from the requirement at the discretion of the fire authority or HM Fire Service Inspectorate;
- are required by law to be provided with adequate means of escape in case of fire;
- are required by law to have reasonable means for fighting fire.

To assist occupiers to comply with these requirements, the Home Office has published a Code of Practice which is available from HM Stationery Office, *Code of Practice for fire precautions in factories, offices, shops and railway premises not required to have a fire certificate,* HMSO.

Fire authorities

Fire authorities:

- may serve a notice on occupiers/owners of steps to be taken before a fire certificate can be granted or amended (NB: such a notice does not override the need to obtain Listed Building Consent);
- must be notified of any intention to make material extension to or structural alteration of certificated premises;
- must be notified of any material alteration in the internal arrangements of the premises, equipment and furnishings;
- may serve a notice requiring improvements to the means of escape and for fighting fire in premises put to a designated use which do not require a fire certificate;
- have power to prohibit or restrict the use of premises if conditions present a serious risk to persons in case of fire.
- may exempt premises from the need to have a fire certificate provided that an inspection of the premises by the authority has taken place within the previous 12 months if, in the opinion of the authority, there is no serious degree of risk from persons on the property.

Fire authority inspectors

Fire authorities appoint inspectors who have the power to:

- enter at a reasonable time any premises to which the Act applies whether or not they are put to a designated use;
- inspect the whole or any part thereof and anything therein;
- make enquiries to find out if the Act and any regulations made under the Act are being complied with;
- request facilities and assistance to be given them in the execution of their duties.

ANNEX 4

LEGISLATION AND GOVERNMENT CIRCULARS RELEVANT TO THE CONSERVATION OF HISTORIC BUILDINGS

Aspects of the subject of the conservation of historic buldings are contained in a number of Acts of Parliament and Statutory Instruments and are also dealt with in departmental circulars. Some of these were covered in Chapter 4. Others include:

Acts of Parliament and Statutory Instruments

- Public Health Act 1961
- Theatres Act 1968
- Town and Country Planning (Scotland) Act 1972
- Town and Country Amenities Act 1974
- Licensing Acts 1964, 1976 and 1988
- Town and Country Planning (Scotland) Regulations 1975
- Ancient Monuments and Archaeological Areas Act 1979
- Local Government Planning and Land Act 1980
- Wildlife and Countryside Act 1981
- Local Government (Miscellaneous Provisions) Act 1982
- Local Government Act 1985
- Cinemas Act 1985
- Town and Country Planning (Listed Buildings and Buildings in Conservation Areas) Regulations 1987
- Town and Country Planning General Development Order 1988
- Town and Country Planning Act 1990
- Planning (Listed Building and Conservation Areas) Act 1990

Circulars

- **Fire Service Circular** *(Home Office) 14/1972*
- **DOE** *(Northern Ireland)* **Circular P63/73, Development by Government Departments,** (particularly Part II)
- **DOE/DAMHB 1982,** *Crown Scheduled Monuments and their Care*
- **DOE/ASB 1982,** *Historic Buildings in the Care of Government Departments*
- **DOE Circular 18/84,** *Crown Land and Crown Development*
- **SDD Circular 21/84,** *Crown Land and Crown Development*
- **HM Customs and Excise, Value Added Tax Protected Buildings** *(Listed Buildings and Scheduled Monuments)* **VAT Leaflet 708/1/85** *(and Amendment dated March 1986)*
- **DOE Circular 8/87,** *Historic Buildings and Conservation Areas Policy and Procedures*
- **SDD Circular 17/87** *New Provisions and Revised Guidance relating to Listed Buildings and Conservation Areas*
- **DOE Circular 18/88,** *Painting of Listed Buildings*

ANNEX 5
SAFE STORAGE OF HYDROCARBON FUELS

Statutory Requirements

Fuel storage is controlled by various Acts of Parliament and consequent Regulations depending on the type of fuel and the amounts stored. There is also a general responsibility imposed upon employers under the Health and Safety at Work Act etc. 1974 to provide a safe working environment.

Petrol

Storage is controlled by the Petroleum (Consolidation) Act 1928 and the Petroleum Spirit (Motor Vehicles etc) Regulations 1929 and the Petroleum Spirit (Plastic Containers) Regulations 1982. The essentials of these controls are that if petrol is intended for use as a fuel for internal combustion engines and is not for resale a limit of 60 gallons (272 litres) is imposed on storage without a licence. This storage must be in suitable containers of not more than 2 gallons (9 litres) capacity. If larger volumes are required application must be made to the local authority for a licence. The FPA strongly recommend that petrol is used only as a motor fuel.

All vessels containing petrol must be conspicuously marked "Petroleum Spirit, Highly Flammable".

Liquefied Petroleum Gas (LPG)

Storage is controlled by the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972. These regulations are restricted to industrial and construction sites. However, the standards set by these Regulations are used by the Health and Safety Executive (HSE) when enforcing the Health and Safety at Work etc. Act and so can be brought to bear on other sites. The relevant points of this act are outlined as good working practices below.

Paraffin, fuel oil and diesel fuel

Storage of these three types of fuel is not specifically controlled but again the Health and Safety at Work etc. Act applies and good working practices should be observed.

Good Working Practices

Detailed information on good working and design practices is available in the references listed below. The essential points to note for all fuel storage are:

- fuel stores should be away from other buildings and boundaries. Minimum distance depends on the type and volume of fuel and construction of the store;
- fuel stores should be secure, well ventilated or preferably in the open air;
- areas around stores and tanks should be free of combustible materials including grass and weeds;
- fuel should not be stored in basements;
- fuel storage areas must be strict no-smoking zones and all other sources of ignition must be avoided in these areas;

- tanks for paraffin, diesel and fuel oil must have bund walls to contain leaks;
- LPG must be stored separately from other fuels;
- a sufficient number of fire extinguishers must be readily available near the store. Dry powder or foam are most suitable. Water must not be used on liquid fires;
- the amounts of liquid fuel drawn from store for portable equipment must be no more than required at the time;
- portable equipment must be filled outside the store area.

Suppliers of LPG and liquid fuels will advise and usually undertake installation and maintenance of permanent plumbed-in supplies. All work on such systems should be done by trained staff. Advice should also be obtained from the local fire brigade and insurers before stores of containers or permanent installations are established.

References

FPA Data Sheets

FS 6027 - Bund walls for flammable liquid storage tanks.

FS 6042 - Oil-fired installations.

HSE Guidance Notes

CS 4 -The keeping of LPG in cylinders and similar containers.

G34 - The storage of LPG at fixed installations

G35 - Advice on the storage of refrigerated LPG, previously contained in guidance note CS5 should be obtained

G50 - Storage of flammable liquids in fixed tanks at sites with a capacity up to 10 000m^3

G51 - the storage of flammable liquids in containers

G52 - The storage of flammable liquids in fixed tanks (exceeding 10 000m^3 total capcity)

British Standards

BS 5410: Code of practice for oil firing.

Part 1: 1977 - Installations up to 44kW output capacity for space heating and hot water supply purposes.

Part 2: 1978 - Installations of 44kW and above output capacity for space heating, hot water and steam supply purposes.

ANNEX 6
USEFUL ADDRESSES

Association of British Insurers
51 Gresham Street
London EC2V 7HQ
Tel: 0171 600 3333

Association of Conservation Officers
c/o Devpt Services
E. Hants District Council
Penns Place
Petersfield
Hampshire GU31 4EX
Tel: 01703 66551 Ext 249

Association of Local Authority Risk Managers
Galaxy Building
Southwood Crescent
Farnborough GU14 0NJ
Tel: 01252 387912

Association for Studies in the Conservation of Historic Buildings
c/o Institute of Archaeology,
31-4 Gordon Square
London WC1H 0PY

British Automatic Sprinkler Association
Carlyle House
235-7 Vauxhall Bridge Road
London SW1V 1EJ
Tel: 0171 233 7022

British Fire Protection Systems Association
48a Eden Street,
Kingston-Upon-Thames
KT1 1EE
Tel: Tel: 0181 549 5855

British Fire Services Association
86 London Road,
Leicester LE2 0QR
Tel: 0116 2542879

British Library
2 Sheraton Street,
London W1V 4BH
Tel: 0171 323 7009

British Standards Institution
2 Park Street,
London W1A 2BS
Tel: 0171 629 9000

Cadw
Brunel House
2 Fitzalan Road
Cardiff CF2 1UY
Tel: 01222 500200

Cathedrals Fabric Commission for England
83 London Wall,
London EC2M 5NA
Tel: 0171 638 0971/2

Chief and Assistant Chief Fire Officers' Association
10-11 Pebble Close,
Amington,
Tamworth,
Staffs B77 34RD
Tel: 01827 61516

Council for the Care of Churches
83 London Wall,
London EC2M 5NA
Tel: 0171 638 0971

Department of the Environment
Building Regulations
2 Marsham Street
London SW1P 3EB
Tel: 0171 276 3000

Department of the Environment (NI)
Clarence Court
10-18 Adelaide Street
Belfast BT2 8GB
Tel: 01232 540540

Department of National Heritage
2-4 Cockspur Street
London SW1Y 5DH
Tel: 0171 211 6000

English Heritage
23 Savile Row,
London W1X 2HE
Tel: 0171 973 3000

Fire Extinguishing Trades Association
48a Eden Street,
Kingston Upon Thames,
Surrey KT1 1EE
Tel: 0181 549 8839

Fire Protection Association
140 Aldersgate Street,
London EC1A 4HX
Tel: 0171 606 3757

Fire Research Station
Garston,
Watford WD2 7JR
Tel: 01923 894040

Furniture Industry Research Association
Maxwell Road,
Stevenage SG1 2EW
Tel: 01438 313433

Health and Safety Executive
Rose Court
2 Southwark Bridge Road
London SE1 9HS
Tel: 0171 717 6000

Heritage Co-ordination Group
Conewood House,
Crawley Ridge,
Camberley,
Surrey GU15 2AN
Tel: 01276 22034

Historic Buildings Council for Wales
Welsh Historic Monuments
Brunel House
2 Fitzalan Road
Cardiff CF2 1UY
Tel: 01222 465511

Historic Scotland
20 Brandon Street
Edinburgh EH3 5RA
Tel: 0131 244 3078

Home Office
Fire and Emergency Planning Department
Horseferry House
Dean Ryle Street
London SW1P 2AW
Tel: 0171 217 3000

Institute of Building Control
21 High Street,
Ewell,
Epsom,
Surrey KT17 1SB
Tel: 0181 393 6860

Institute of Plumbing
64 Station Lane,
Hornchurch,
Essex RM12 6NB
Tel: 014024 72791

Institution of Electrical Engineers
Savoy Place,
London WC2R 0BL
Tel: 0171-240 1871

Institution of Fire Engineers
148 New Walk,
Leicester LE1 7QB
Tel: 0116 2553654

International Council on Monuments and Sites
10 Barley Mow Passage,
London W4 4PH
Tel: 0181 994 6477

Joint Committee of National Amenity Societies
St Anne's Vestry Hall
2 Church Entry
London EC4V 5HB
Tel: 0171 236 3934

Lead Sheet Association
St John's Road
Tunbridge Wells
Kent TN4 9XA
Tel: 01892 535028

Loss Prevention Council
140 Aldersgate Street,
London EC1A 4HY
Tel: 0171 606 1050

Loss Prevention Certification Board
Melrose Avenue
Borehamwood
Hertfordshire WD6 2BJ
Tel: 0181 207 2345

Museums and Galleries Commission
16 Queen Anne's Gate
London SW1H 9AA
Tel: 0171 233 4200

National Approval Council for Security Systems
Queensgate House,
14 Cookham Road,
Maidenhead,
Berkshire SL6 8AJ
Tel: 01628 37512

National Trust
36 Queen Anne's Gate,
London SW1H 9AS
Tel: 0171-222 9251

National Trust for Scotland
5 Charlotte Square
Edinburgh EH2 4DU
Tel: 0131 226 5922

Royal Commission on the Historical Monuments of England
23 Savile Row,
London W1X 2JQ
Tel: 0171 973 3500

Royal Institute of British Architects
66 Portland Place,
London W1N 4AD
Tel: 0171 580 5533

Royal Institution of Chartered Surveyors
12 Great George Street,
London SW1P 3AD
Tel: 0171 222 7000

Scottish Office
St Andrew's House
Edinburgh EH1 3DG
Tel: 0131 556 8400

Society for the Protection of Ancient Buildings
37 Spital Square,
London E1 6DY
Tel: 0171 377 1644

Thatching Advisory Service
Rose Tree Farm
29 Nine Mile Road
Finchampstead
Berkshire RG11 4QD
Tel: 01734 734203

Timber Research and Development Association
Chiltern House,
Stocking Lane,
Hughenden Valley
High Wycombe,
Bucks HP14 4ND
Tel: 01240 243091

ANNEX 7

REPORTS OF NOTABLE FIRES

Type of building:	**School**
Town:	Bedford
County:	Bedfordshire
Date:	4 March 1979
Constructed:	1891
Estimated loss:	£1 400 000
Supposed cause:	Arson following break-in and burglary

This school was founded in the mid-fifteenth century and was renowned for its internal decoration. The Great Hall with oak panelling and large leaded-light windows was an outstanding feature.

The building involved in the fire comprised the Great Hall which extended from ground-storey level to the roof on the front face of the central part of the building plus classrooms and offices. These were situated in all three storeys at the rear of the Great Hall and in two wings. Access to the classrooms in the upper storeys was by a staircase in each wing and by means of cantilevered galleries, which were constructed of pressed steel trough, with concrete infill and a finished surface of parquet flooring. There were fire-resisting self-closing doors leading to the staircases in all storeys which were held open on electromagnetic door retainers. They operated only if the fire alarm sounded or the mains supply failed.

On the afternoon prior to the fire, the Great Hall was being prepared for an evening film show. At 1400 hours two pupils detected a faint smell of burning at the stage end, but the smell disappeared almost immediately and no trace of burning could be found. At that time, one of the boarding houses in the vicinity had a bonfire and as the wind was blowing in an easterly direction, smoke could have been carried towards the school, thus accounting for the burning smell. During the evening the film was shown and afterwards the head porter visited and made the building secure for the night, leaving it at about 2155 hours.

The first of 36 calls to the 999 operator with notification of a fire was at 2358 hours. When the fire brigade arrived at the school, the front of the Great Hall and the roof were well alight. Nearby buildings were evacuated because of the wind which was blowing large embers on to property down wind of the fire. An initial attack was made on the rear face of the building where fire was beginning to break through. A request was made to the water authority for the water pressure to be increased. Two portable pumps were also in use, pumping water from the school's swimming pool.

Fire-fighting operations progressed smoothly and by 0320 hours, the fire was under control having involved all three storeys and caused the roof to collapse. Fire brigade crews remained at the fire ground until the early hours of 5 March to deal with deep-seated pockets of fire which had been buried by debris.

The seat of the fire was difficult to ascertain because of the extensive damage, but it is believed to have started at the stage end of the Great Hall where the blaze was more intense.

Development of the fire was assisted by combustible linings. It was able to spread through all levels over the open galleries.

The provision of fire-resisting doors and screens prevented fire spread within the staircase enclosures with the exception of the second-storey level where fire spread over the doors and screen through the roof area. A walkway extended through the apex of the roof, along the whole length of the Great Hall. The doors must have closed when the electricity was cut off by the fire as evidenced by the lack of charring on one side of these doors.

Type of building:	**Stately home**
Town:	Heveningham
County:	Suffolk
Date:	8 June 1984
Constructed:	1780
Estimated loss:	£1 500 000
Supposed cause:	Butane blowlamp

This Georgian mansion house was built in 1780 and consisted of three floors and a basement. The building was constructed of a large amount of combustible materials including timber within walls, ceilings, floors and the roof. The large rooms had decorative plaster ceilings.

In the late afternoon of 8 June 1984, a woman driving a car on a road which skirts the extensive grounds noticed one window of the Hall lit up with flames. She raised the alarm by alerting the occupants of a cottage in the grounds.

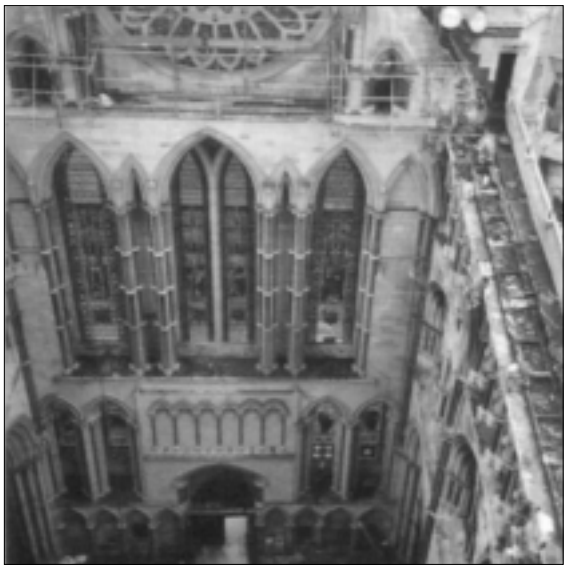
Part of the building's first aid fire-fighting protection was a large number of 6kg BCF extinguishers. The Clerk of Works mustered a fire-fighting party to use these extinguishers prior to the arrival of the fire brigade. The extinguishers proved ineffective against the well-developed fire which by that time involved several rooms and so the staff withdrew, closing doors behind them.

On arrival, the officer in charge of the first fire brigade appliances saw a severe fire in the first floor of the east wing and made pumps eight before his appliance had turned into the main drive. The initial attack was made by a team equipped with breathing apparatus taking a jet into the building at the first floor level, via scaffolding erected to the exterior of the east wing. The fire was found to be spreading rapidly from the east wing into the centre of the building via corridors at first and second floor levels. Because of the heat and smoke, breathing apparatus had to be used in these areas and fire fighters were then able to drive the fire back down the corridors.

At the time of the fire, the building was being extensively renovated and internal restoration of the east wing was nearing completion. It is thought that the fire was caused by a painter using a blowlamp to burn off paintwork on a window frame.

Fortunately during the renovation period the antique furniture usually located within the east wing had been removed. Some extremely valuable paintings and furnishings were salvaged from the building during the fire and at one point fire crews entered the ground floor library of the east wing before it became involved in the fire and removed a valuable chandelier.

Type of building:	**Place of worship**
Town:	York
County:	North Yorkshire
Date:	9 July 1984
Constructed:	1200
Estimated loss:	£4 500 000
Supposed cause:	Lightning



The Minster security officer was on duty in the north transept when the fire alarm operated. He went to the police office where the alarm system panel indicated a fire condition in Zone 8 of the south transept. The alarm was received by the brigade at 0230 hours and within 4 minutes two pumps were in attendance.

On unlocking the door leading into the south transept the security officer became aware of flames discharging from the underside of the roof vaulting in the south-west corner. After a short delay while the key to the door leading into the south transept tower was found, fire crews gained access to the roof void and discovered a severe fire involving the complete roof.

The fire brigade attempted to put ladders up to the triforium but were unsuccessful due to molten lead showering down from the roof. The fire developed quickly, spreading inwards, causing a total collapse of the roof by 0400 hours. It was finally controlled by 0524 with the flames prevented from spreading up into the central tower.

The fire is believed to have started in the roof void near an access door situated at the south-west corner of the south transept. The degree of charring of the heavy section timbers indicated that the fire had been burning for some time prior to the alarm being raised. The delay in the actuation of the system may have been caused by the design of the roof which meant that the detectors were positioned 5m below the apex of the roof thereby allowing a space for smoke to collect undetected. Alternatively the detectors could have been made inoperative as a result of a lightning strike. If this was the case then at a later stage in the fire development, a short circuit could have occurred between the fire-damaged wiring insulation and the enclosing metal conduit completing the circuit and actuating the alarm.

It is considered that the most likely cause of the fire was a lightning strike which discharged either onto the lead roof or the horizontal conducting strip along the roof ridge igniting dry timbers in the south-west corner of the south transept.

Type of building:	**College**
Town:	Dewsbury
County:	West Yorkshire
Date:	16 November 1985
Constructed:	1889
Estimated loss:	£4 500 000
Supposed cause:	Unknown

The section of the building principally affected by the fire was the four-storey plus basement wing of 75m x 30m which formed the southern arm of the U-shaped complex of buildings which comprised the college. Because the ground sloped downwards from north to south the basement of the southern wing was partly exposed above the ground level and windows in the upper part of the wall provided a source of natural light for the basement rooms. The college provided courses in the arts, humanities, science and technology but the southern wing was primarily used for the teaching of science and technology.

The original floors and ceilings were mainly of timber with floorboards on 200mm x 75mm joists and lath and plaster underneath. In parts of the building an unusual feature had been introduced: a secondary ceiling had been installed, at some later date, about 600mm below the original ceiling and the void formed by the space between the two ceilings was used for service pipes and cable runs. Subsequently, apparently for reasons of thermal insulation, a third ceiling had been constructed 900mm below the secondary ceiling. The effect was to lower the ceiling height from its original 4m down to 3m, to incorporate the upper row of windows into the concealed voids and to produce a network of hidden spaces through which fire could travel, fed by the materials of construction.

The fire was believed to have started in the basement staffroom. The college superintendent who lived opposite the college was awakened by a crashing noise, probably caused by the partial collapse of the ground-storey flooring, at 0559 hours. Going to his window he saw flames emerging from the staffroom windows and he immediately contacted the fire brigade using a 999 telephone call, which was the first of six calls received by brigade control. The fire brigade responded by despatching the predetermined complement of three pumping appliances and one hydraulic platform. When the first appliance reached the college at 0630 hours the staffroom was well alight and flames were coming out of the windows with such intensity that the stonework above the windows was spalling.

Within the building the fire progressed rapidly, spreading horizontally and vertically aided by the ceiling voids. Fire-fighting jets were deployed but, with an obviously deteriorating situation, the officer-in-charge requested further assistance. As the fire developed, seven main jets were put into action together with four ground monitors, two turntable ladders and one hydraulic platform manned and controlled by 122 fire brigade personnel. Because of the heavy demands upon the water supplies, water relays had to be set up requiring the use of 20 pumping appliances. The fire was attacked from three directions by ground-based jets. An aerial attack was made by jets from turntable ladders and the hydraulic platform but difficulties were encountered as the ridges of the multi-pitch roof shielded areas of the roof and upper storeys from the direct application of water.

It is believed that fire started in the basement staffroom of the college
Photo: *Huddersfield Examiner*

Nevertheless, the fire damage was confined to the south wing of the college, housing lecture theatres, laboratories, workshops and other ancillary rooms. Fortunately, particularly hazardous materials which included 0.22 calibre ammunition, radioactive materials and pathogenic specimens were stored in sections of the college unaffected by the fire.

The college was heated by a computerised central heating system which employed temperature sensors throughout the building and records of the temperature readings in the various parts of the premises were preserved. It was found that at 2100 hours the previous night the temperature in the staffroom registered 21°C whereas the temperature in a nearby classroom was 19°C. The heating system was then shut off and the temperature in both rooms decreased at approximately the same rate until 0258 hours when the staffroom sensor registered 25°C while the classroom sensor indicated 14°C. The temperature in the staffroom continued to rise until at 0306 when the sensor registered 40°C after which it failed; the classroom sensor continued to record a temperature of 14°C until 0600 hours when it too failed.

Therefore, it seems that there was a slow smouldering fire for a prolonged period in the staffroom which preheated the room before bursting into an intense flaming fire.

The previous evening at 2100 hours the caretaker and his wife heard voices and the sound of breaking glass and so the possibility that burning material had been thrown into the staffroom cannot be ruled out. However, it is also possible that smouldering material such as a cigarette had remained overlooked when the staff left the building at 1715 hours the previous day.

Although the cause was not firmly established it was concluded that an initially slowly developing fire originated in the staffroom beneath a desk adjacent to an external window.

Type of building:	**Royal Palace**
Town:	Hampton Court
County:	London
Date:	31 March 1986
Constructed:	1514
Supposed cause:	Naked flame
Estimated loss:	£20 000 000

The whole palace covers an area of 6 acres which includes buildings and enclosed court yards. It stands in approximately 45 acres of ground mostly landscaped to gardens. Construction began in 1514 by Thomas Wolsey who presented the palace to Henry VIII. During the reign of Henry VIII and successive monarchs the palace was enlarged and many alterations and much rebuilding works were carried out. At the time of the fire the building consisted of some 1000 rooms interconnected by numerous corridors and staircases. There were also numerous voids and vents which were presumed to be for the circulation of air for heating purposes (heat from "domestic fires"). The existence of these voids was previously unknown, and it was only after the fire when panelling was removed that they were discovered.

The fire precautions within the building consisted of internal hose reels and extinguishers which were situated on all floors. Sprinklers were not installed in view of a perceived potential for damage to valuable paintings. There was an internal fire telephone system which was connected to an indicating panel in a permanently manned control room. In addition there were both smoke and heat detectors throughout the building.

At 0300 hours a routine security patrol was carried out by two men. They passed through the cartoon gallery at some time between 0345 and 0400 hours and found nothing unusual. At 0520 hours an intruder alarm sounded in the control room. At this time the fire alarm showed a fault in Zone 10. Two members of the security staff were dispatched to investigate. The first floor was searched and no one was found. The ground floor was not checked.

As one of the security men sent to investigate was about to return to the control room he noticed something falling from the ceiling in the cartoon gallery. On closer inspection he saw what he described as "bubbling" of the paintwork. He then telephoned the control room to report the possibility of a fire in the ceiling.

Thick black acrid smoke was discovered in a corridor above the cartoon gallery and the fire brigade was called.

On arrival the station officer observed approximately 9m^2 of the gallery ceiling alight. Part had fallen to the floor of the gallery and was still burning. A crew was instructed to provide a ladder and line of hose to that room via the window. The brigade was informed of the likelihood of persons trapped in rooms above the fire, and breathing apparatus teams were sent in. Three people were assisted from the premises. The crews then entered another apartment where they encountered thick black smoke with almost nil visibility. The situation became rapidly untenable and due to a rapid build-up in heat the breathing apparatus crew had to withdraw, and then re-enter with a jet.

Photo: *The Guardian*

There was imminent danger of the fire spreading, crews were therefore deployed in an attempt to surround the fire. It was also decided to vent the roof which in itself was a major problem; it took six men working with crow bars almost 20 minutes to roll back sufficient of the inch-thick lead sheet. When the roof was eventually vented conditions within the building were greatly eased.

During the fire fighting, brigade personnel assisted with the removal of valuable art treasures. The body of a woman was later recovered from the building.

The fire brigade's operations were eventually "closed down" on 6 April.

At the inquest it was stated that the cause of the fire was probably a naked flame.

Type of building:	**School**
Town:	Aberdeen
County:	Grampian, Scotland
Date:	2 July 1986
Constructed:	1863
Estimated loss:	£4 500 000
Supposed cause:	Hot-air paint-stripping gun

The school, housed in a range of buildings, mostly constructed of granite, was erected in 1863. Like many buildings of its age, its internal fire loading was high, with combustible materials such as timber, fibreboard and chipboard being widely used for wall linings.

As part of the maintenance programme, window sills, parts of the pulley stiles and window frames were being renewed. One window opening had been fitted with a new sash window and new sash cords, but some of the pulley stiles had not been renewed. Before painting the whole window, the old paint on the stiles was being removed with an electric hot-air gun. The workman doing this noticed smoke coming from the window, and went to look for the janitor to get a fire extinguisher. About 8 minutes elapsed before he could find the janitor who gave him a CO_2 extinguisher; they both returned to the window and discharged the extinguisher at the top of the stile. About 5 minutes later, another tradesman noticed smoke coming out of the roof, and activated the internal alarm.

On arrival, the fire brigade were confronted with a major fire in the roof with smoke pouring from that part of the building. The fire spread rapidly through the roof space and on more than one occasion overtook the firemen who were cutting open the roof to permit a direct attack. Stops were eventually effected, as shown on the plan. Thirteen pumps eventually attended this fire, which was fought with 15 jets from five hydrants. The fire in the roof was fought using two turntable ladders and a hydraulic platform.

Photo: D. C. Thompson & Co Ltd

The fire was clearly caused by hot air from the gun igniting the sash cord; this, in turn, had ignited the outside of the pulley stile; flames had been drawn through the pulley hole, and spread up inside the wall to involve the roof, which at this point was very near the top of the window. The roof was a single, uncompartmented space, allowing rapid flame spread; it also had a double timber skin.

The building was severely damaged and 14 rooms were destroyed by fire. A number of irreplaceable historical documents were also destroyed.

Type of building:	**Place of worship**
Town:	Hurst Green
County:	Surrey
Date:	1 April 1988
Constructed:	1913
Estimated loss:	£700 000
Supposed cause:	Malicious ignition

On Good Friday evening fire fighters were called out to a fire in a parish church. On arrival, smoke and flames were seen issuing from the ground storey of the bell tower. As fire fighters fought the fire which originated in the choir vestry, the church was becoming smoke-logged. The fire progressed through the timber floors to involve the timber roof of the main church. Four pumps were initially sent to the incident but due to the growing fire and the height of the building, two more pumps and a hydraulic platform were requested.

As more appliances arrived, additional breathing apparatus crews were committed to the main body of the church. The construction of the roof, with an arched timber ceiling some 1.3m below the ridge, made the application of water very difficult. Fire fighters working from 15m ladders removed sections of the roof covering to provide fire-fighting access. Meanwhile breathing-apparatus crews who were working in the bell tower had to withdraw due to danger from falling floor timber. Fire-fighting then continued from outside. At 2049 hours the blaze was finally brought under control, though appliances were kept at the scene through the night and into the following day. Six jets were in use at the height of the blaze with six pumps and a hydraulic platform. During the operation, mains water supplies from hydrants had to be supplemented by water pumped from a nearby river.

Ninety per cent of the church roof was destroyed by fire and the entire contents, floor and roof of the bell tower were severely damaged. The fire was started deliberately in the choir vestry, where duplication spirit and candles had been ignited. Evidence of liquid burn patterns were discovered in the floor covering. A man was charged by police in connection with this incident.

Type of building:	**Place of worship**
Place:	City of London
Date:	10 May 1988
Constructed:	1670
Estimated loss:	£2 000 000
Supposed cause:	Heat from blowlamp ignited roofing material

Photo: *The Independent*

The Church of St Mary at Hill, designed by Sir Christopher Wren, was badly damaged when fire broke out in the roof area.

After the arrival of the first fire crews at 0201, pumps were increased to eight with more than 50 fire brigade personnel attending the incident. The fire was brought under control at 1443 hours.

Most of the bell tower and three-quarters of the roof of the church were destroyed in the blaze, the remainder sustaining heat and smoke damage. A large number of stained-glass windows were also damaged and half of the church was affected by heat and smoke.

Type of building:	**Castle**
Town:	Braidwood
County:	Strathclyde
Date:	7 June 1988
Constructed:	1785
Estimated loss:	£600 000
Supposed cause:	Suspected arson

The two-storey building, constructed in 1785, consisted of stone walls with a timber, slate and bitumen roof. The castle was used as a private dwelling. The fire was discovered at 0518 hours and a 999 call was immediately made to the fire brigade. The occupier then tried to use a hose reel from inside the building to extinguish the fire, but was unsuccessful.

Eight pumping appliances and 49 brigade personnel were involved in the fire-fighting operations. It took the brigade approximately two hours to bring the blaze under control with the last appliance leaving the scene at about 1230 hours the following day.

The fire is thought to have started within a cupboard and caused severe damage to 30% of the building with the remainder receiving slight heat and smoke damage.

Type of building:	**Stately home**
Town:	Cullen
County:	Grampian, Scotland
Date:	17 January 1989
Constructed:	Part 13th/part 20th century
Estimated loss:	£667 000
Supposed cause:	Carelessly discarded cigarette end ignited combustible material

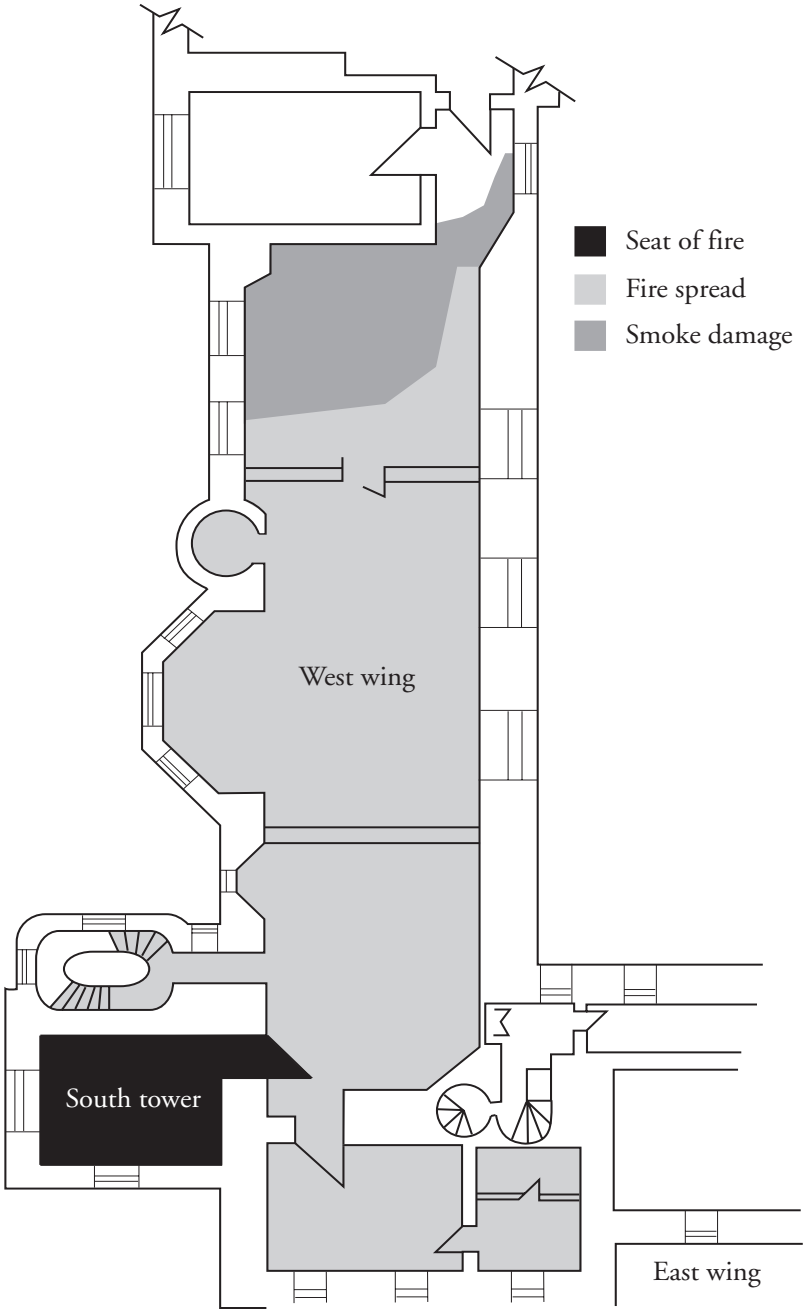
Photo: Aberdeen Journals Ltd

At about 0630 hours a motorist noticed smoke issuing from the south tower of the house and alerted the occupants who telephoned the fire brigade and evacuated the building.

On arrival of the predetermined attendance of three pumps at 0645 hours, fire crews found the first, second and third floors of the south tower involved in fire. Additional appliances were mobilized and, at 1002 hours the fire was extinguished. At the height of the blaze one turntable ladder monitor, eight jets and 12 breathing apparatus sets were in use.

The first, second and third floors and roof spaces of the south tower were destroyed with severe fire, heat and smoke damage to the east and west wings. Most of the ground floor sustained water damage.

Following investigation it is believed that the fire had been smouldering for several hours.


Seat of fire
Fire spread
Smoke damage
West wing
South tower
East wing

Smoke had been detected in the east wing about seven hours prior to the discovery of the fire but no action was taken as it was thought to come from a log fire. However, the fire spread rapidly due to the internal timber construction and the modern contents. Although there were few remains of the upper floors of the south tower, other than external walls, it was possible to establish the second floor as the seat of fire because of the lateral severity of damage to adjacent property in comparison to lesser affected areas in other floors.

Several causes of fire were considered:

Illegal entry and arson were ruled out due to the time scale of the fire's development. However, scaffolding had been placed against external walls which gave access to open windows and a key for workmen was left outside. Also, over the previous three years, the fire brigade had received six malicious calls about the building.

Electrical: there has been a history of overloading and short-circuiting of the 5 amp circuits which was evident on inspection of the fuse board as it showed continual blowing of fuses. Significantly, the 5 amp fuse was rated at 15 amp which could have led to the overheating of the wiring insulation if there was a fault in the circuit. However, electricity as a cause of the fire was ruled out, as the 5 amp circuit could not be traced higher than the ceiling of the first-storey lounge and the seat of fire is thought to have been above this height.

Smoking materials: at least six workmen who were known smokers were in the building before the fire. It is therefore considered that a carelessly discarded or forgotten cigarette had found its way into soft furnishings and smouldered for several hours before igniting surrounding materials.

Type of building:	**Stately home**
Place:	Uppark House
County:	West Sussex
Date:	30 August 1989
Constructed:	1690
Estimated loss:	£25 000 000
Supposed cause:	Heat from oxy-acetylene torch being used to weld lead ignited roof timbers.

Photo: Times Newspapers Ltd

At the time of the fire Uppark House was open to the public. An extensive programme of work on the roof, which had been severely damaged in the October 1987 storm, was nearing completion. Scaffolding surrounded the building and workmen were finishing the final areas of lead work at roof level on the southern side of the building.

When the first call was received by fire brigade control four appliances were dispatched, the first arriving at 1555 hours. Fire and smoke were, by then, issuing from roof level at the southern end with smoke also issuing along the full width of the building. Two fire fighters wearing breathing apparatus were deployed internally with a high pressure hose reel to locate the seat of fire in the second storey, while a branch was put to work externally from the scaffolding at second-storey level. By this time evacuation was well under way. The three other appliances arrived soon after and at 1604 hours pumps were made six. The crew inside the building had reached the second storey where smoke was at ceiling level and had started to tackle the blaze.

Wind conditions were deteriorating with gusts reaching Force 8. Conditions within the building were also worsening with fire breaking through the ceiling in the east corridor.

Although a second breathing apparatus crew had entered the building, they were unable to control the fire and were forced to withdraw from the second storey because of collapsing ceilings. Fire was also seen externally through the roof between the south-eastern and south-western corners, despite three jets being deployed from the scaffolding.

At 1614 hours pumps were made eight but were increased 2 minutes later to 12. Efforts were being made to supplement water supplies from static sources and to salvage the contents of the building. The salvage operations had been started initially by National Trust staff. Pumps were increased to 20 at 1624 hours in order to mount an extensive brigade salvage operation, attack the fire and to sustain water supplies by shuttle and relay. By this time appliances from West Sussex, Hampshire and Surrey were in attendance. Special appliances were also requested including a hydraulic platform, hose layer, control unit and two water carriers.

A massive salvage operation was begun with personnel working in hazardous conditions to retrieve the contents of the house. As a result of these actions 95% of the basement and ground storey contents were saved plus some of the contents from the first storey before the roof collapsed. At the same time firemen were attacking the blaze from the scaffolding and with the aid of the hydraulic platform.

Fire-fighting operations were hampered by the need to maintain water supplies. Because the house was in a rural area, 1.5km from South Harting, and was built on top of a hill, water supply to the house, by means of an electrically operated borehole pump, was poor. Fire fighters used other static supplies which included 115 000 litres from the swimming pool 550m east of the house, 90 000 litres from a static tank also 550m east of the house, and 45 000 litres from an underground tank 180m west of the house. A portable dam was erected at the entrance to the drive at the north side and initially kept filled by a shuttle. These appliances had to obtain their supplies from a 75mm hydrant in South Harting whilst a 1.4km water relay was being set up.

At 1717 hours a further five pumps were requested for the relay in order to maintain water supplies. This was necessary as the water authority were unable to boost the pressure. However, a water relay from a private lake was eventually established which enabled fire fighting to continue.

The stop message was finally sent at 2336 hours, but crews continued damping down and salvage operations for a further 4 days. The fire resulted in the total destruction of the roof and second storey with 75% of the rest of the building sustaining damage by fire and collapse.

Following an exhaustive and painstaking examination of the building and debris, investigating officers returned the cause of the fire as heat from an oxy-acetylene torch being used to weld lead igniting roof timbers.

Almost six years after the event, the legal issues resulting from the fire were finally ruled on by the Court of Appeal.

The contractor responsible for the roof work failed in its bid to avoid liability for restoration of the house.

The Court of Appeal rejected the argument that the contractor was relieved from liability for the fire under its contract. Earlier in 1994 the High Court had ruled that contractual arrangements did not excuse a contractor from the consequences of its own negligence and this ruling was upheld by the Appeal Court.

Type of building:	**Greengrocers and café**
Town:	Stockport
County:	Cheshire
Date:	6 November 1989
Constructed:	Greengrocers - 1600; Café - ca. 1450
Estimated loss	£2 000 000
Supposed cause:	Malicious ignition

A policeman on patrol saw what he thought was steam coming from the building and alerted police control at 1619 hours. A second call confirmed there was a fire.

When the fire brigade arrived at 1625 hours they found that the fire had started in a ground-floor room of the greengrocers used for storage. Some external doors were found to be open. Using two jets from a hydrant and one aerial monitor, firemen brought the blaze under control at 1931 hours.

The fire resulted in severe damage to the room where the fire started including total loss of the timber staircase and door. Further severe damage occurred to a large portion of the first and second floors with about two-thirds of the roof timbers destroyed.

An investigation into the cause of fire determined that paper and wooden boxes had been ignited with matches. Timber used in the staircases and enclosures allowed the fire to spread to open-plan rooms in the upper storeys.

Type of building:	**Theatre**
Town:	Westminster
County:	London
Date:	12 February 1990
Constructed:	1910
Estimated loss:	£10 million
Supposed cause:	Not determined

The Savoy Theatre in the Strand was being renovated and redecorated and was due to open on 20 February 1990. At 0143 hours on the 12 February 1990 the automatic sprinklers covering the stage area behind the metal safety curtain operated and activated the alarm. The fire brigade were summoned automatically and the first appliance arrived at 0149 hours to find a well-established fire. The flames were brought under control after about two hours by the fire brigade using ten jets. Four fire fighters were injured, two with burns, one with cuts and one with a sprain, while fighting the fire. The last appliance left at 1409 hours.

The fire was largely confined to the auditorium by closed fire doors and the stage safety curtain, there was no automatic fire detection or suppression system in the auditorium itself. The large volume of air coupled with the slow-burning traditional horse-hair upholstery in the auditorium allowed the fire to develop undetected for some time. The safety curtain was breached at the top and the sprinklers activated only when the fire was well developed.

The whole of the auditorium was severely damaged by fire and the roof partly collapsed. The auditorium had Grade II listed decoration of the art deco style designed in 1939 by Basil Ionides. Most of this was lost.

The adjacent Savoy Hotel was evacuated during the fire but did not sustain any damage.

Damage to the theatre and contents alone were estimated at £10 million; additional consequential losses included the cost of relocating a planned production.

The fire is thought to have started towards the rear of the stalls but the exact cause was not established.

Type of building:	**Town gatehouse**
Town:	Totnes
County:	Devon
Date:	4 September 1990
Constructed:	12th century
Estimated loss:	£3 000 000
Supposed cause:	Unknown

Flames destroyed the unique Grade 1 listed Eastgate, the last of the Totnes three medieval gates and damaged a number of Grade 2 listed timber-fronted merchants' houses just after 0100 hours on 4 September 1990. Some 100 square metres of buildings in the centre of the town were affected.

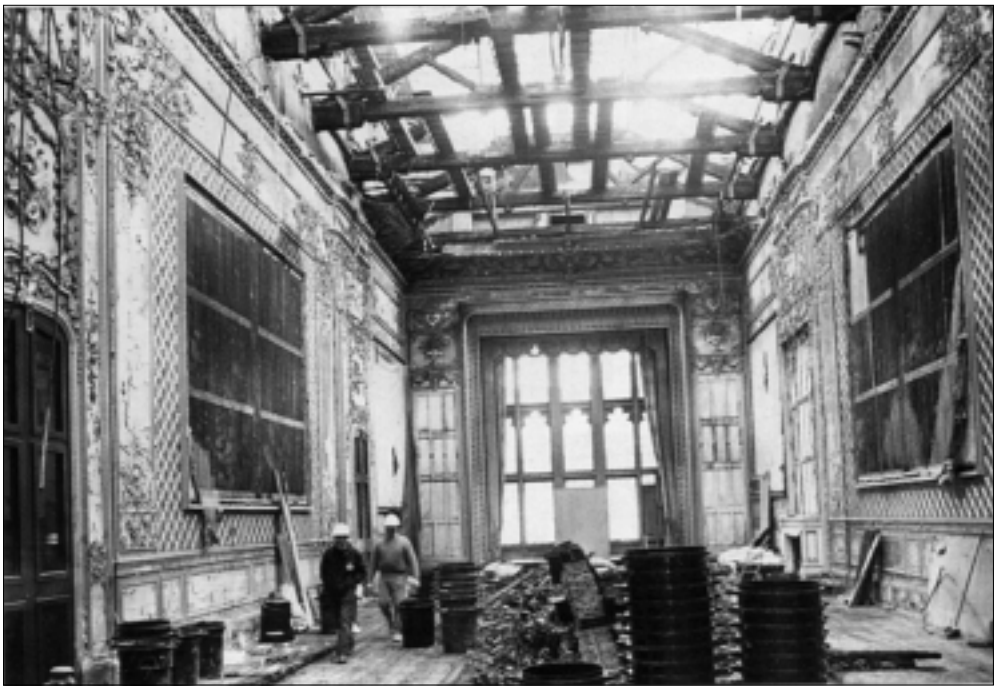
The fire originated in an estate agent's office next to the 13th century arch, and many people were evacuated as flames spread down sides of a narrow road.

More than 100 firemen attended the incident and fought the fire with water pumped from the River Dart.

Contents of the buildings, which were restyled in the early 19th century, included linenfold panelling and friezework reputedly originating from Berry Pomeroy castle. The local council worked with the owners of the buildings, with the advice of English Heritage, to ensure replacements achieved a high authentic standard.

The cause of the fire had never been established but it was reported that no evidence of arson had been found.

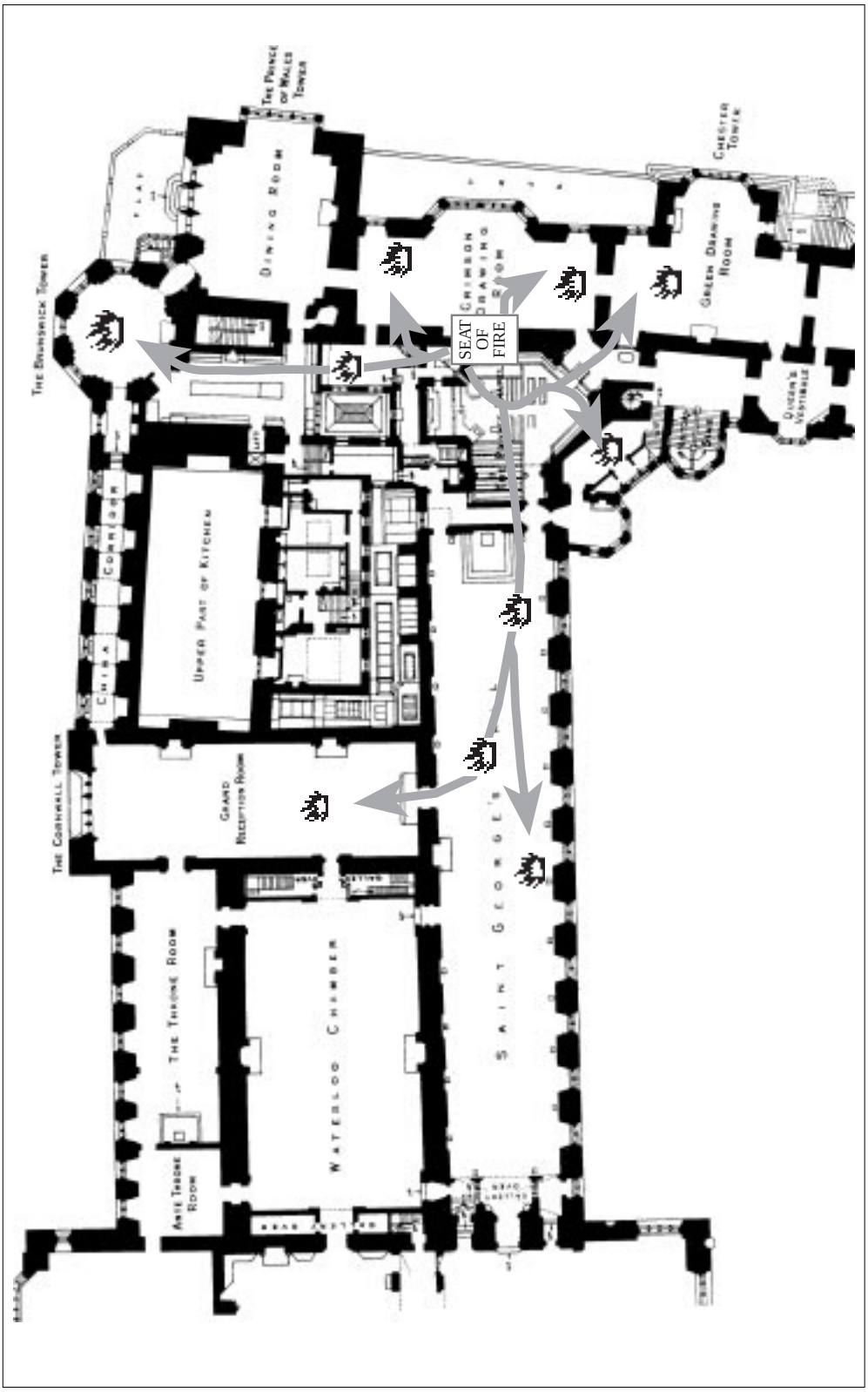
Type of building:	**Royal Palace**
Town:	Windsor
County:	Berkshire
Date:	20 November 1992
Constructed:	17th and 19th century
Estimated loss	£20 000 000
Supposed cause:	Curtain too close to electric light



Windsor Castle has belonged to the sovereigns of England since the days of William the Conqueror. Part of the Castle dates from the 13th century but the buildings involved in the fire had been built in the 17th century and during the last reconstruction in the 1820s.

As a result of the Hampton Court fire (1986), an upgrading of the fire precautions at the Castle was in progress (the Kingsbury project) including rewiring, compartmentation by cavity barriers and installation of an automatic fire detection system. However, the work had not reached the area to be involved in the fire.

On the morning of 20 November 1992 three picture restorers entered the first-floor private chapel adjoining St George's Hall to work on paintings standing on "A" frames in the chapel. They switched on the lights to the chapel including some spotlights 3.5m above floor level that illuminated the altar. However, they were not aware of the presence of the lights as they were hidden behind a pair of heavy floor-to-ceiling curtains of 6m drop drawn to screen the altar. The spotlights were normally only switched on when the curtains


The Prince of Wales Tower
Dining Room
Crimson Drawing Room
Chester Tower
Green Drawing Room
Queen's Vestibule
The Brunswick Tower
Flat
SEAT OF FIRE
Upper Part of Kitchen
Corridor
China
The Cornwall Tower
Grand Reception Room
Saint George's
Waterloo Chamber
The Throne Room
Ante Throne Room

were drawn back. The curtains were hung very close to the lights and may have been pushed against them by pictures leaning against the curtains.

At 1120 hours a plumber working on the roof saw smoke issuing from vents on the roof of St George's Hall. He apparently did nothing about it. At about the same time one of restorers smelt smoke in the chapel. About 10 minutes later the three restorers together saw flames coming from the back of the curtain near to the top. They all went for help and one phoned the Castle switchboard which reported the fire to the Control Room at the Castle fire station at 1135 hours.

The Castle fire brigade comprises six full-time and 11 part-time fire fighters and a salvage team of 25 residents on call. When the call came in, the Castle fire appliance was 2 miles away dealing with a spill of hazardous materials. The Control Room contacted the fire appliance by radio, sounded the fire alarm and alerters to call the part-time fire fighters and called the local authority fire brigade. The fire appliance at Windsor fire station (only 2 minutes away) was, however, engaged in other fire-fighting duties 6 miles away.

Meanwhile contractors alerted by the restorers attacked the fire with 9 litre water extinguishers without success. Hose reels provided less than 20m away were never brought into action.

The Castle fire appliance arrived at the scene at about 1141 hours but by the time fire fighters equipped with breathing apparatus (BA) had gained access to the chapel the ceiling and roof were on fire, and there was little they could do to contain the fire. Meanwhile HRH Prince Andrew, staff and contractors began salvaging the priceless contents of rooms threatened by the fire.

At 1144 hours two fire appliances arrived from Slough 3 miles away, the first local authority appliances to arrive on the scene. Requests successively radioed for additional pumping appliances: 1148 hours make pumps ten, 1156 hours make pumps 15, 1212 hours make pumps 20, 1303 hours make pumps 25 and at 1429 hours make pumps 35. Three aerial appliances were also in attendance.

At 1250 hours seven jets, one hydraulic platform monitor and 20 BA sets were in operation. At the height of the fire 31 jets and two monitors from hydraulic platforms were in use, from which it has been calculated that 20 800 l/min were pouring onto the fire.

Despite the massive fire-fighting operation, the fire continued to spread except where compartmentation had been installed as part of the Kingsbury project. It was not until fire breaks were made at the Chester Tower and the Clock Tower and the roof opened up for ventilation, that the spread of fire was stopped and the blaze brought under control. The fire was contained by 1630 hours but was not under control until 2303 hours, $11^1/_2$ hours after the initial call.

The fire caused severe damage to the Brunswick, Prince of Wales and Chester Towers, and to the private chapel, St George's Hall, the Grand Reception Room, the State Dining Room, the Holbein Room and the Crimson and Green Drawing Rooms. However, because many pictures had been removed from the walls for restoration, only one major picture was destroyed. The cost of repair to the Castle fabric is estimated to be between £20 million and £40 million.

Among the lessons learned from the fire were the need for automatic fire detection, training of visiting workers, compartmentation and fire-stopping of voids, flame-retardant treatment of curtains, trained salvage teams and liaison with the brigade (see Annex 8 for the recommendations resulting from the official enquiry).

ANNEX 8

SUMMARY OF CONCLUSIONS OF THE REPORT INTO FIRE PROTECTION MEASURES FOR THE ROYAL PALACES[†]
by Sir Alan Bailey KCB

The main strategic recommendations are as follows:

(a) For each agency there should be a **fire safety policy statement** and effective mechanisms throughout the management structure for implementing this policy. The fire safety policy should have regard to all normal activities but also to any special or occasional events which may take place.

(b) Each agency should appoint an individual at senior level as **Fire Safety Manager**, with personal responsibility for implementing the fire safety policy.

(c) The Fire Safety Manager, who will have other duties, should be assisted by a full-time expert **Fire Safety Officer**.

(d) Each agency should have a central **fire safety committee**, meeting at least once a year, and a fire safety committee for each Palace, meeting at least twice a year, to review fire risk management and ensure that the fire safety policy statement is implemented.

(e) Each Palace should have a **senior member of staff responsible for fire safety**.

(f) Each Palace should have a **fire safety manual**, setting out its strategy and detailing its plans in case of fire, as a basis for training; and a **log-book** to record all fire-related events.

(g) There should be a professional survey to carry out a **detailed fire risk assessment** of each Palace and make recommendations for safety improvements consistent with preserving the historic fabric; in most cases this is in train. This should be followed by **regular inspections** to check progress with the agreed implementation programme and subsequent maintenance of fire safety standards, and a full professional **re-survey and fire safety audit** once every five years. Each agency should **report annually** to the Department of National Heritage on progress with implementing its fire safety strategy in accordance with these recommendations.

(h) A full analogue addressable **automatic fire detection and warning system** should be installed in each of the Palaces, to the highest British Standard; the system should then be **rigorously checked and maintained** to keep the number of unwanted calls down to a low target figure. Management must ensure that this is fully logged and monitored.

(i) Following the full survey each Palace should implement recommendations to **establish fire-resisting compartments, segregate areas of high fire risk and protect escape routes.**

(j) **Fire certificates** required under the Fire Precautions Act 1971, where not already issued, should urgently be obtained. But it should be noted that certificates will apply only to designated areas (eg offices and shops), not to all areas to which the public is admitted.

(k) Agency managements should make systematic, properly recorded **training** arrangements to ensure that all staff know how to minimise fire risks, and how to raise the alarm at the first sign of fire; and to provide enough fully trained staff to tackle incipient fires immediately and safety with fire-fighting equipment.

(l) For all **Palace residents**, an initial detailed fire survey of their apartments should be carried out and implemented. There should be quinquennial re-surveys; and annual reminders to check electrical appliances, with an offer of expert advice.

(m) There should be clear fire safety requirements in all **contracts** for building, maintenance and other work, and for special events; the management should check that these precautions are being taken, and should carry out a **fire safety check** on all significant proposals for changes in use.

(n) Each Palace should have a **trained salvage team**, with regular exercises in co-operation with the local fire brigade; and detailed plans for the salvage of contents.

(o) Palace managers should **liaise regularly with local fire brigades** on the risk management, fire-fighting and salvage, and arrange practice exercises.

(p) Provided all our other recommendations are implemented, the extra risk reduction which would be achieved by a full up to date sprinkler system would not be worth the extra costs, including heritage costs, of installing such systems throughout the Palaces.

(q) The detailed surveys should examine whether, in special high-risk situations (for example, in some work-rooms, stores or basements), a **partial sprinkler system** would be cost-effective.

(r) There should be a programme to prepare and maintain **architectural records** of the Palaces.

(s) There should be arrangements for **co-ordination**, and common funding, of **research** between the agencies, the National Trust and other bodies concerned with fire safety in heritage buildings.

ANNEX 8A

CONTENT OF A FIRE SAFETY MANUAL

The Bailey enquiry particularly commended the following approach to a fire safety manual

(Developed for English Heritage and reproduced with their permission)

1 DESCRIPTION OF BUILDING
1.1 General layout of Estate and buildings
1.2 Use of building(s)
1.3 Construction of building(s)
1.4 Contents of building(s)

2 STATUTORY CONTROLS
2.1 Building Regulations 1991
2.2 Fire Precautions Act 1971
2.3 Health and Safety at Work etc Act 1974
2.4 Insert titles of other statutory controls

3 FIRE SAFETY STRATEGY
3.1 Objectives
3.2 Life safety
3.3 Property protection

4 MANAGEMENT POLICIES FOR FIRE SAFETY
4.1 Management structure for fire safety
4.2 Executive responsibilities for fire safety
4.3 Staffing levels
4.4 Staff training
4.5 Disabled persons
4.6 Risk management
4.7 Fire evacuation procedures
4.8 Salvage and damage controls
4.9 Testing and maintenance of fire safety systems
4.10 Building works
4.11 Special events
4.12 Fire Safety Committee
4.13 Amendment to manual
4.14 Insert other sub-headings if required

5 RISK MANAGEMENT AND FIRE SAFETY AUDITING
5.1 Fire prevention, housekeeping and safe working practices
5.2 Visitor facilities
5.3 Residential accommodation
5.4 Security
5.5 Special events

ANNEX 9
CHECKLISTS

In historic buildings, as in any other property, it is important that a safety routine is adopted and adhered to. It is suggested that the following is adopted as the basis of a periodic checklist but it should be noted that BS 5839: Part 1 has specific additional requirements† in respect of fire detection systems:

Daily:
- Check that fire exits, hydrants and drains are not obstructed.
- Check that no goods, furnishings or stores have been placed too near lights, heaters or sprinkler heads.
- Test unmonitored automatic fire alarm connections to the fire brigade or central fire alarm depot. Check that every lamp in a maintained emergency lighting system is lit. Clean and lubricate machinery.
- Remove waste material before large amounts accumulate.

Weekly:
- Test monitored automatic fire alarm connections to the fire brigade or central alarm depot.
- Actuate a detector or manual call point to test a monitored fire alarm zone (test a different zone each week).
- Test a fire alarm sounder circuit.
- Check fire alarm back-up batteries and connections.
- Inspect electrical equipment to ensure that no unauthorised extension leads or adaptors are in use.

Monthly:
- Check that each self-contained emergency lighting luminaire illuminates when failure of the normal supply is simulated.

Quarterly:
- Check correct functioning of fire alarm control and indicating equipment.
- Check the condition of back-up batteries and charger for the fire alarm system.

Six-monthly:
- Ensure that a routine maintenance visit has been made by a representative of the intruder alarm company.

Annually:
- Check that the fire alarm battery supply will maintain the system for 30 minutes.

Three-yearly:
- Engage a qualified electrician to test and inspect the electrical installation.

† BS 5839: Part 1 requirements: Weekly tests - at least one detector, call point or end of line switch on one circuit should be operated to test the ability of the control and indicating equipment to receive a signal and to sound the alarm and operate warning devices. Different detectors, manual call points and circuits should be tested each subsequent week in a set sequence. Monthly, quarterly and annual tests should be similarly specified.

Last thing at night check that:

- electrical appliances are switched off and unplugged;
- ashtrays are emptied and no smouldering cigarette ends have been overlooked;
- all portable heaters are turned off;
- all cookers are turned off;
- where possible, electricity and gas supplies to outbuildings have been turned off at the mains (but not the fire and security alarm systems or the emergency lighting);
- exterior doors are locked, windows are shut and secured and interior doors are closed;
- any bonfire outside the premises has been extinguished;
- waste materials have been removed from the building to a metal container outside;
- all keys have been returned to the key-board or cupboard;
- access for the fire brigade is clear;
- the security alarm system is turned on.

Whenever necessary:

- keep areas in the immediate vicinity of premises clear of combustible vegetation by cutting and removing grass and shrub;
- if hot work has been undertaken ensure that regular inspections are continued, if necessary, after normal opening or working hours.

Further details of maintenance procedures, especially with regard to fire alarm, emergency lighting and security alarm systems are described in British Standards. Publications from the National Approval Council for Security Systems describe procedures for intruder alarm systems. Additional advice may also be obtained from The Loss Prevention Council and insurers.

ANNEX 10

LANHYDROCK - A CASE STUDY IN FIRE PROTECTION PLANNING

The staff of Lanhydrock House working with Cornwall County Fire Brigade in practising their fire emergency procedures

An outstanding example of management and employees working hard to put the principles of preplanning for damage control into practice, is at Lanhydrock House. Lanhydrock House is one of the premier tourist attractions in Cornwall, with 150,000 visitors every year. The building was completed in 1642 by the Robartes family, who lived there continuously until the death of the Honourable Everild Agar Robartes in 1969.

In 1881, a devastating fire destroyed the kitchen area and south and east wings of the house. The north wing was only saved by the drastic action of dynamiting a fire break. The family resolved to rebuild the house and wisely incorporated features to reduce the risk of a recurrence of such magnitude.

The construction was of concrete and steel, with as much fire proofing as was known to Victorian engineering! A 70,000 gallon reservoir was built in the hillside above the house, which gravity-fed 12 hydrants placed strategically around the exterior of the house and at all stair heads. The Viscount brought a "Manor" fire engine from Merryweather and started his own volunteer fire brigade for the estate and surrounding area. He was also instrumental in setting up a fully manned station at Bodmin and the link between Lanhydrock and Bodmin fire station has survived to the present day.

Lanhydrock is now owned and managed by the National Trust and is considered to be the flagship of the Trust in Cornwall.

Colour-coded plastic bags are used in conveying books out of Lanhydrock House

Following the Hampton Court fire, the National Trust set up a working party to review its risk management procedures. In July 1989, it issued two documents - *Fire Precautions at Historic Buildings* and *Emergency Procedures in Historic Buildings* and circulated them to all regions and house administrators.

When considering how best to implement those directives, the Cornwall Region decided to concentrate resources at Lanhydrock House, initially training up the first house team in the region and then to expand their role to respond as the Cornwall Region Team because of their central position in the county.

The fire brigade was asked to expand their annual inspection into a full house fire prevention survey, so that any recommendations could be included in a schedule of work. The survey was extensive and the recommendations far-reaching.

They included a complete upgrading of the fire detection system, the compartmentation of the house and roof spaces and the introduction of a new fire main and hydrant outlet.

To introduce fire doors into an historic building requires sensitivity of design, constant consultations, skilled craftsmen and considerable funding. To date, five new fire doors have been completed and installed and other doors upgraded; the entire fire detection system has been replaced and a new fire main and hydrant system installed.

During that same period of time, they have worked very closely with the fire fighters of Bodmin Fire Station to set up and train their salvage support team. Members of Cornwall County Brigade were understandably wary of the thought of National Trust support teams being let loose anywhere near an emergency scene without clear working boundaries and responsibilities having first been established, but they were very interested in the positive advantages that could be gained from such a group. The support teams were selected from the fittest people on Lanhydrock estate, the builders, gardeners and wardens, each group working with their department head as team leader and one other as a nominated deputy.

Lanhydrock is a large house with 32 rooms open to the public and a further 50 used as private accommodation, restaurant, shop and storage. To ask anybody to familiarise themselves with such a vast area on a part-time basis is not practical and so each team familiarised themselves with one wing of showrooms each. They have prime responsibility for their wing and then act as support in any other area of the house.

The time scale for this was from November 1989 to April 1990, during which time it was established which items of the thousands in the house were a priority, their location, fixing and security, both during and after a salvage operation. Storage and conservation areas were designated for both short and long term situations. Site management areas, police interview and press briefing rooms were designated and first aid positions established and

equipped. "Sleeping" contracts were negotiated with specialist hire companies, removals firms and a freezer company for the conservation of the books. Finally, a training area was set up in a disused section of the Harness Block.

The Gallery houses a unique collection of books, so 2,000 books were purchased from a local library for £30 to test various evacuation and conservation techniques initially from the Harness Block and later from the Gallery itself. Staff trained on average one hour per week from April to November 1990.

A fourth support team was introduced to prepare all the equipment required as the incident unfolded and then to assist with conservation of the salvaged objects. This group was made up from the conservation cleaners and restaurant staff as they have the greatest knowledge of handling and wrapping precious artifacts.

By November 1990, they were confident enough in their progress to hold a large-scale exercise at the house, involving the Fire Brigade and they also invited conservation advisers from London, to advise both the support team and fire brigade on the handling and conservation requirements for paintings, ceramics, books, furniture and metals. Personnel from the region were also invited as observers to assist them to set up their own house teams. The exercise took place in three areas of the house simultaneously to stretch the support teams to the limit, working with the fire brigade, who were using key-boards provided by the house to gain access to locked compartments. The contents of a mock up of the dining room were evacuated under the supervision of a fire officer, then rules changed as the fire brigade, under the instruction of the support leader, sheeted up and protected those large items that could not be moved, such as built-in dressers and plaster overmantels. The system to evacuate books from the gallery was also tested, using chutes constructed from sailcloth. This proved very worthwhile, as it poured with rain on the day and the chutes became sodden and the books stuck, so the system had to be re-thought.

Training continued throughout the winter and a tighter risk management policy was implemented, by introducing a six-monthly house inspection carried out by house and regional management staff. Electrical and electronic maintenance contracts, fire detection and extinguisher systems were all negotiated on a six-monthly basis. Chimney sweeping was increased to quarterly. All hot work and smoking was banned and the first fire check door was completed and installed.

In April, a repeat exercise was held, as part of Bodmin Fire Station's inspection by the Home Office Fire Inspectorate. The purpose was to involve the part-time fire crews from Liskeard and Lostwithiel and also to test the National Trust response outside of office hours. The opportunity was also taken to test the newly installed fire main. The chutes were used again to evacuate the books but book slings on ropes were used to transport plastic inner liners down the chute.

This method cut down the handling both in the building and in the salvage areas and more than 2000 books were evacuated in under 25 minutes. The inner liners were colour-coded, so that conservators could quickly recognise which books needed most urgent attention and what damage they had suffered: blue - water damage; green - smoke damage; red - good condition. This addition to the original concept was the result of one of the earlier debriefing sessions.

Whilst the practical exercise was in progress at the house, Regional Office staff were implementing the designated telephone trees to call management, conservators, utility companies, hire companies and stewards and to check if they would have been available to respond, had there been an emergency. The response rate was just under 25%, which was more than the figure originally conceived in the contingency planning.

Fire precautions and emergency procedures have always formed a part of the National Trust management training courses and housekeeping study days. In 1990, the first specific Emergency Procedures study day was held at Kingston Lacey. In the following year, the venue was Erddig, near Wrexham and in 1992, Lanhydrock House. The training days are used to pool information from the regions and avoid re-inventing the wheel. The course was expanded to three days, to give enough time to assimilate the information and incorporate a practical element into the training.

Prior to the exercise phase, there were three days of intensive training in the following subjects:

Handling and packing ceramics
Glass and miscellaneous objects
Inventories, role of Conservation Department
Handling and storage of sculpture, protection of stonework and plasterwork
Handling and storage of furniture
Handling and packing of books
Handling and storage of textiles
Handling and storage of paintings
Handling and storage of metalwork
Emergency support team, equipment and procedures
Fire precautions and fire fighting (double session)
Post trauma stress

There were also talks relating to planning for emergencies, dealing with the press, alternative types of fixtures and fittings, the importance of risk management, the importance of working closely with the fire brigade and security measures in an emergency.

The developments that have evolved at Lanhydrock through a process of assessment planning, implementation and ongoing evaluation have been possible, due to the commitment and co-operation of all involved and provide an excellent example of what can be achieved. Liaison with the fire brigade has ensured a professional approach by the National Trust and kept training on a practical level that will be of benefit to all concerned in the event of an emergency.

ANNEX 11

SECURITY MEASURES IN LISTED BUILDINGS

General note: It must be remembered that any additions to listed buildings may require listed building consent

1 Technical aids to security

Security Lighting

The value of security lighting should not be overlooked both in terms of its deterrence to intruders but also as an aid to security personnel. Good lighting can also be used to provide a safe working environment at night.

While low-cost high-intensity lighting units controlled by a motion sensor are now readily and cheaply available some thought should be given to the selection of mounting points.

If it is decided to utilise motion-operated devices it should be realised that the passive infrared sensor which such devices contain can be operated by animals and therefore if the exterior of the house or premises which is protected hosts rabbits or other animals care should be taken to ensure that the sensor field is carefully adjusted to reduce unwanted actuation of lights.

The interconnection of exterior lights (especially when set to dazzle an intruder) and an alarm system can be most effective and has, reportedly, on a number of occasions panicked would-be burglars into fleeing.

Lighting should be arranged so as to illuminate approach paths to the building while allowing occupants to maintain surveillance of any persons approaching.

Consideration should be given to the impact of the possible loss of external power supplies.

As with all security technology, lighting is a specialist subject and competent advice should be sought.

Closed circuit television

CCTV is now relatively inexpensive and is sometimes offered as a panacea for a wide range of security problems. Care should exercised in accepting this sort of advice but judicious use of cctv can, under some circumstances be cost-effective.

The following questions should be asked before deciding on installing cctv:

1. Who is going to monitor the screens displaying the information ?
2. For how long ?
3. What are they going to do if they spot an intrusion ?
4. Who will respond to deal with the intrusion ?

CCTV has a valid use in many listed buildings in providing surveillance of interiors particularly where valuable items are being displayed. In this respect, heritage buildings are similar to retail premises where judicious use of cameras and recorders can be a valuable adjunct in the prevention of theft or malicious damage.

As in other cases where substantial expenditure is contemplated it is suggested that a specialist consultant be employed to design the system. Before accepting a quotation for

a system it would be wise to insist on a proper survey including the simulation of the proposed camera locations during the day and at night.

The use of recording devices can be helpful in dealing with the aftermath of an intrusion or theft and care should be taken that recording devices are maintained in good condition and actually switched on. Tapes should be rotated and disposed of after having been used for the life specified by the manufacturer.

Use of Hidden CCTV Cameras

Very small cctv cameras which use fibre optics and concealed lenses are now readily available. Such equipment can be moved from location to location. This type of equipment can utilise batteries and be fitted with 'wire free' connections to a video recorder. The equipment can, for instance, be installed above a suspended ceiling and use a hole less than 2mm in diameter for its lens.

Such equipment correctly used could provide a wide range of evidence of wrong doing or breaches of security procedures, particularly if it was suspected that staff or contractor personnel were involved.

Access Control Systems

At its simplest an access control system need be no more than a lock and its key. Modern security parlance however tends to use the term to refer to a network of sensors, electrically-controlled locking devices and a control system which will provide a range of features. In larger premises, consideration could be given to the installation of a proprietary system consisting of the following configuration:

- a data collection and monitoring network
- a centralised control and display unit
- individual door unlocking/locking devices

Each door deemed to be in need of protection from unauthorised use can be fitted with an electrically- operated device (either in the form of a magnetic lock or an electromechanical latch) which would hold the door locked. When an authorised person needs the door to be opened, a signal from the sensor is picked by the control equipment and upon verification a signal back to the door will cause it to release. The operation is simultaneously logged by the control equipment.

In the case of heritage buildings, particularly those containing libraries, museums or galleries, it is suggested that the decision as to the most appropriate type of sensors will include an evaluation of the following:

- swipe readers
- swipe reader with data entry
- proximity or 'hands-free' readers

While other types of sensors are available (retinal scan, palm print scan, fingerprint reader and simple data entry) it is suggested that the levels of protection required demand at least the security of individual coded cards.

Swipe cards are familiar to most people and are often now found in banks where they allow holders of credit cards into lobbies containing cash dispensers. The addition of the data entry facility means that after the card is swiped through the reader an individual code has

to be entered. Thus to gain access through a protected door one must not only possess the correct card but also know the relevant code number.

The sophistication of such systems is now remarkable, allowing very fine control. For example, a system could be configured which would allow, say, cleaners through a single door only between 0600 and 0601 hours on alternate Tuesdays. Any attempt to use the card outside these hours would result in an alarm being operated and an exception report would be printed out identifying which card was being misused. Lost or invalid cards can be keyed out of the system in seconds and new employees added using the control system keyboard.

Clearly to install whichever system is selected will be expensive. The programme could however be phased using a list of priorities. Once the control equipment (usually an IBM compatible PC) and the data network is established then doors can be added to a system as budgets permit.

Matters which should not be overlooked concern the doors themselves, The doors and frames must of course be well constructed and be fitted with good quality closing devices. It is suggested that the optimum type of securing device is the magnetic lock. This requires the least maintenance and is very tolerant of frame and door distortion. Whichever type of lock is specified it must of course comply with fire regulations and permit passage in an emergency. This can be best done by interconnecting the access control system to the fire alarm panel so that if an evacuation is signalled all doors automatically open.

All doors should be fitted with sensors to signal if they are left open. The sensors should activate a local audible alarm

2 Security staff and patrolling

Whatever the extent or complexity of electronic security equipment installed in a building the regular security patrol is an essential feature of any fire safety and security programme.

Patrols should be undertaken according to a routine established by the owner or manager and should, at times when the house or premises are open to the public, include not less than two complete rounds of the premises every 24 hours. One of these rounds should commence during the hour after the public or visitors depart,

In larger or more complex premises a series of patrol circuits should be established which allow a variety of routes to be chosen. A log of patrols including details of irregularities detected should be maintained and checked regularly by a responsible person.

Security guards should be trained not only to undertake patrolling but also to deal with fire matters as well as other emergencies. An outline of guard activities together with other useful information follows.

Duties of security guards

Security guard's main functions are:

1. To detect and prevent fire.
2. To detect and prevent any criminal damage and vandalism.
3. To ensure rules are observed, such as smoking prohibitions.
4. To detect and prevent theft.
5. To prevent accidents.
6. To assist in the reception and handling of visitors.

Checklist for patrols

1. Check all buildings, offices, working areas etc. to ensure there is no fire, water or other hazard.
2. Ensure that all rooms and buildings left locked for security purposes are in order, with no interference to doors, padlocks, windows, rain pipes etc. Padlocks should be carefully scrutinised to ensure they have not been filed open or cut off with bolt croppers and substituted by others.
3. Check any rooms or buildings apparently left inadvertently unlocked. If there are no signs of interference, and there are no specific instructions to notify the occupiers, lock and make a note of the incident.
4. Investigate all unusual lights and report.
5. Investigate all appliances left running.
6. Note any defects in the buildings, fences, lighting etc that might result in damage or personal injury.
7. Check perimeter fences and investigate any breaks that are found.
8. In case of any hazard observed which may cause or produce an accident, take steps as are necessary to remove the danger forthwith.
9. Investigate and challenge any person found on the premises whose presence may be suspicious.

Advice on the employment of security personnel can be obtained from a wide range of organisations including insurers and local police crime prevention officers.

3 Strengthening wooden shutters[†]

1. Wooden shutters are often found in older premises fitted over the inside of windows and even glazed doors. The following method of strengthening such shutters has been found possible depending on design and condition of the shutters. Simple two-leaf shutters - one at either side - is the design that lends itself most easily to this treatment. Multi-leaf shutters that fold back one leaf upon another are not so amenable to the following methods.

2. (a) Each leaf of the shutter is to be clad on the external face with sheet steel, the thickness of the steel being dictated by the ability of the leaf to carry the extra weight.

   (b) If the steel sheet cannot be put on the external face of the shutter the internal face may be so clad but this is the least desirable option.

   (c) For extra strength both faces of the leaf may be clad with sheet steel.

Method

(i) Single lining - external - the sheet steel should be wrapped around the top, bottom and both edges of the leaf and secured with coach bolts at 100mm centres (nuts to the inside of the thread burred) and with non-return screws at 50mm centres round the top, bottom and both edges.

[†] *Reprinted by kind permission of the Security Advisor, Museums and Galleries Commission.*

(ii) Single lining - internal - to cover the inside surface of the leaf BUT NOT the top, bottom or edges, secured with non-return screws at 50mm centres.

(iii) Double lining - the sheet steel should be fitted as in (i) and (ii) above and secured by coach bolts at 100mm centres passing through both external and internal sheets (nuts to the inside with threads burred).

(iv) Any gap between the leaves of shutters should be protected by either a flat bar or T-bar suitably installed to overlap the leading edges of both leaves by a minimum of 50mm.

3. The shutter hinges will need replacing and additional hinges installed to carry the extra weight. The hinges must be so designed that the plate is fixed to the masonry reveals at right angles to the plane of the window. Most original hinges do not conform to this recommendation as the hinge plates are commonly fixed to the window frame in the same plane as the window.

4. (a) A steel locking bar (or bars depending on size of the shutter) must then be provided across the internal face of the shutter to hold it securely in the closed position. A single bar is recommended for shutters up to four feet in height and two bars for longer shutters. The bar(s) to be of steel at least $^1/_4$ inch thick and $2^1/_4$ inches wide.

(b) A single bar should cross the shutter horizontally and be fixed into the masonry reveals across "U" brackets fixed to the shutter face. It must be locked into the closed position by padlock.

(c) On large shutters two bars may be used horizontally in the same manner as described at (b) above. Alternatively, for ease of operation two bars may be top-hung from staples securely bolted to the masonry reveals being brought down in a crossed configuration when the shutter is closed and padlocked to bottom staples also bolted to the masonry reveals.

5. To complete protection of a window or glazed door in this fashion, the shutters need to be supported by a vibration sensor connected to the intruder alarm system. This will signal an attack upon the shutter before intrusion occurs. The position of the sensor needs to be agreed with the intruder alarm engineer so as to avoid accidental activation induced by shutter vibration due to non-criminal causes such as wind. It has been found that the best position for the sensor on or near the hinge plate or secured to the reveals can be checked by field testing.

ANNEX 12

OCCASIONAL USE OF HISTORIC BUILDINGS (INCLUDING CHURCHES) FOR SLEEPING PURPOSES

The following precautions should be taken when premises are used for conferences, seminars, youth weekends etc. for which ad hoc sleeping accommodation is provided:

1 Special care should be taken when utilising space other than on the ground floor for sleeping accommodation.

2 There should be at least two separate routes leading from the sleeping accommodation and out of the building. A room with two exit doors leading into the same corridor, from which there is only one exit which could be impeded with smoke and fire, should not be considered acceptable.

3 External doors should be left unlocked when the premises are occupied unless they are fitted with a panic latch or similar equipment. If, for security purposes, this is impracticable the only fastening should be a simple tower bolt. Exit doors should be checked for ease of opening.

4 Exit routes and doors should be clearly indicated.

5 In order to minimise the spread of smoke and fire, should an outbreak occur, all doors and serving hatches should be kept closed, particularly during the night hours.

6 Portable heating appliances should be avoided if at all possible. Where their use really is essential, they should not be sited in positions in which they would impede exit routes and doors, should they catch fire. They should be turned off during sleeping hours.

7 An outbreak of fire often causes a power failure. It is therefore necessary for supervisory staff to have battery-operated hand lamps, unless the premises are equipped with emergency lighting.

8 Smoking should be forbidden in areas used as sleeping accommodation.

9 A Nominal Roll of occupants should be prepared and hung just within the main exit door. Occupants should be instructed to meet at a predetermined assembly point in the event of fire and a roll call should be taken.

10 Anyone discovering an outbreak of fire should raise the alarm by shouting "Fire", or, if the premises are equipped with a fire alarm system, operating the nearest available fire alarm or break glass point.

11 Supervisory staff should be aware of the location of the nearest telephone. They should also check that it is in working order. The Fire Service must be called to all fires (however small).

12 Cars should not be parked where they would obstruct exit routes, access for fire appliances or fire hydrants.

13 Supervisory staff should be familiar with the location and trained in the action to take in case of fire and in the method of operation of the fire-fighting equipment. Fire fighting should only be carried out when it is obvious that it is safe to do so.

ANNEX 13

THE FIRE PRECAUTIONS (PLACES OF WORK) REGULATIONS. SUMMARY OF POSSIBLE CONTENTS
Based on September 1994 draft

Regulations will apply to all places of work where one or more people are employed - with a few exceptions.[†] Additionally, the extent of fire safety precautions required will be determined by a risk assessment for which the employer is responsible - it is worth noting that in smaller premises this need not be a particularly lengthy or difficult task.

In practical terms, it is suggested that most workplaces will have to be provided with at least the following:

- a fire risk assessment and an emergency plan (the finding of the assessment and the plan to be in writing).

The main action points for employers to follow in order to comply with the Regulations are:

- identify fire hazards;
- identify any staff and other people who are especially at risk;
- remove/reduce fire hazards and provide additional fire safety measures if necessary;
- record findings of the fire risk assessment and action points;
- consider arrangements for people with disabilities;
- prepare the emergency plan;
- provide enough exits for everyone to get out in good time;
- ensure that all escape routes and exits are available for use;
- provide an appropriate means of giving warning in case of fire;
- arrange the checking, testing and maintenance of fire safety equipment;
- keep appropriate records;
- ensure your staff are adequately informed and trained;
- include fire safety in your health and safety policy for the workplace.

Small premises (where fewer than five people are employed at any one time) will subject to the requirement for a fire risk assessment (but this need not be in writing) and must have an emergency plan. However, the employer (or occupier) will probably only need to ensure that adequate means of escape exist and that basic fire safety measures such as exit signs and portable fire extinguishers are provided.

It is proposed that the Regulations will not apply to premises which are covered by other fire precautions legislation requiring the provision of fire safety measures equivalent to the standards required by the Regulations. On that basis, exemptions from the Regulations are proposed for most premises where a fire certificate or licence is in force. The Regulations will apply to Crown premises, but premises occupied by the Crown will remain immune from enforcement.

[†] *Exemptions exclude premises where the only employees are domestic staff and premises with a valid fire certificate issued under the Fire Precautions Act 1971.*

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Heritage Under Fire

A guide to the protection of historic buildings

Second edition

This guide is aimed those who have any form of responsibility for planning, advising about or setting up fire safety measures in historic buildings.

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