Fire research news 1995

SIMPLE GAS DISPERSIONMODELS FOR FIREGROUND USE

Bryan Johnson

Fire Research News 19

Over the past few years, there has beena significant increase in the size and number of premises producing, usingand storing bulk quantities of toxic and flammable gases, and in the frequencywith which these have been transported through the country. As a resultof this, there is a growing likelihood of incidents involving major releasesof toxic and flammable gases. Given the wrong weather and atmospheric conditions,such a release could cover several square miles.

A number of local authorities have plansfor dealing with such releases and, in some areas, computer facilitiesor factory technicians are available to assist, but in many areas thisis not the case, especially with incidents involving road or rail tankers.

It is apparent that there is a need fora simple fireground method for estimating the areas threatened by an accidentalgas release. Consequently, the Fire Experimental Unit (FEU) was asked tocarry out a study to identify the types of computer packages and othersuch facilities available for predicting gas dispersion, and to assessthe viability of producing a simple method that could be used by firstattendance fire crews.

To fully appreciate the available computerpackages and other facilities, you need to have a basic understanding ofthe behaviour of gases. The two major factors that affect the way in whicha gas disperses in the atmosphere are the density of the gas and the meteorologicalconditions during its release.**Gas Density**

Gases are generally categorized by densityand are referred to as being either buoyant (light), neutrally buoyantor dense (heavy).

Buoyant gases are lighter than air andso generally they spread upwards away from the source of the release. Buoyantgases are very rarely a cause for concern unless the release occurs instable weather conditions.

Neutrally buoyant gases have a densitywhich is similar to that of air. Consequently, the dispersion of thesegases is greatly influenced by the meteorological conditions during andafter release. In most weather conditions, a neutrally buoyant toxic orflammable gas release can cause hazardous conditions over large distancesat ground level.

Dense gases can pose a significant hazardin almost all atmospheric and weather conditions. Initially, due to theeffects of gravity, a dense gas is likely to spread equal distances radiallyaround the site of the release to form a pancake' cloud at ground level.This cloud may remain at ground level, and the gas at high concentrations,for long periods of time. Consequently, attendance upwind does not necessarilyguarantee that contact with the released gas will be avoided. Dense gasesare also likely to find their way into basements and underground culvertsto pose further hazards. Accidental releases of chemicals during transportare most likely to involve dense gases.

The behaviour of all types of gases canbe unpredictable when released in the vicinity of complex terrain, suchas narrow valleys or in urban areas.
Meteorological Conditions

The dispersion of gases is also stronglyaffected by wind speed and atmospheric turbulence.

The path that a buoyant or neutrally buoyantgas takes is mainly influenced by the prevailing wind. Under steady' windconditions the material would move in a straight line directly down-wind,slowly spreading out as it moves. However, wind is not often steady interms of either direction or speed. Consequently a gas plume meanders'as it drifts.

The initial movement of a dense gas pancake'cloud is generally influenced more by the effects of gravity on the gascloud than by the wind. However, once the momentum of this initial gravityeffect has reduced, the prevailing wind begins to influence the movementof the gas.

Generally, the mixing of a gas with airdepends on the atmospheric stability.

Extremely unstable conditions can occurin the United Kingdom on cloudless summer days. These conditions can leadto efficient mixing of a released gas with air and hence a quick reductionin chemical concentration. Very stable conditions can occur in the UnitedKingdom at night time when combined with low wind speeds. Here, there isstrong cooling of the ground and the lower layers of the atmosphere, butthere is warmer air higher up. This is known as temperature inversion andresults in very poor gas dispersion with slow air/gas mixing.

Available Facilities

There are a large number of computer packagesavailable for the prediction of gas dispersion (in excess of 100). However,these packages generally require the gas release rate to be determined.Consequently, they are not appropriate for fireground use because theyrequire information which is unlikely to be initially available at an incident.The data requirements could be simplified but it is likely that the modelswould still be too complex and too time consuming for use by first-attendancefire crews.

The weather information provided by theUK Meteorological Office's CHEMET service is extremely valuable to theemergency services. However, the estimate they provide of the likely area-at-risk'from the dispersing gas is not provided quickly enough (it takes around20 to 30 minutes) to be of use to first-attendance fire crews. Also, thisestimate does not account for dense gases or complex topographical situations.

Template systems have been in use in industryfor many years and are known as workbooks' or handbooks'. These workbooksoften consist of templates which are site and chemical specific for a particularproduction facility and are extremely easy to use. If an accidental chemicalspill should occur, then the correct template is selected, depending onthe prevailing conditions, and overlaid on a map of the site and the surroundingarea. The relevant emergency procedures are then followed.

Any simple method for predicting the areasthreatened by the accidental release of gas would have to ignore terraindetails such as buildings, hills, valleys, drainage systems and so on.However, the interaction of these with dispersing gases is not generallywell understood or modelled. Consequently, this is a limitation of most,if not all, existing computer packages, workbooks and other methods.

For situations where an accidental gasrelease takes place in areas of complex terrain, modelling is generallyinappropriate and alternative fire service procedures may have to be considered.

A gas dispersion prediction system is requiredby the fire service that is quick, easy and relatively simple to use, isinexpensive and provides estimates that are reasonably accurate. The CHEMETservice provides valuable weather information but does not provide gasdispersion predictions quickly enough and computer packages are inappropriatebecause they require more information than is likely to be available atan incident. The provision of a workbook, or something similar, for thefire service could meet the requirement. A workbook could contain templatesthat could be laid on to 1:50,000 scale Ordnance Survey maps. It shouldbe possible to select templates via a decision tree based on atmosphericinformation only, however the initial buoyancy of the escaping gas mightalso be required.

Further Developments

The FEU have been tasked with evaluatingany currently available simple workbook type gas dispersion predictionsystems. So far, three systems have been identified which are based aroundsmall handbooks that could be carried on first line appliances. These systemshave originated from the Netherlands, Switzerland and the USA and varyconsiderably in the amount of information and expertise required to usethem.

The FEU are currently assessing these threesystems. However, from initial inspection, it seems that some of theiraspects could be developed to produce a simple workbook for use by theUnited Kingdom fire service.

CHEMICAL DECONTAMINATION- FURTHER TRIALS

John Rimen

Fire ResearchNews 19

Following the assessment of the effectivenessof chemical decontamination methods used by brigades (CFBAC Research ReportNo. 63), the Fire Experimental Unit (FEU) has recently completed some trialson a newly available chemical decontamination system, marketed by FireFogging Systems of Newmains, Strathclyde. The results obtained were mostencouraging when compared with those from the earlier trials, which werereported in Issue 17.

The system, which has been developed specificallyfor this application, uses a high pressure water and detergent fog (typicallysome 70 bar), at a flowrate of about 4 litres per minute, and is designedto enclose and contain virtually all of the fog and run-off.

The rest of the equipment comprises of:a fog nozzle (in effect, a small, very light, hosereel gun); a petrol drivenwater pump; a water heater, powered by a petrol driven generator; a lightweightwater tank of 140 litres capacity; and detergent.

The detergent can be induced into the wateras it flows from the pump, or a solution can be pre-mixed in the watertank. This solution is warmed and fed via a steel-braided high pressurehose (of which any length can be supplied), to the hand held nozzle, whichis located in the tent. All of the variables: nozzle pressure, flowrate,water temperature, detergent concentration, etc. are determined and pre-setat `the pump end'. The fog nozzle simply has a well-guarded on/off trigger.

The trials undertaken by FEU were designedto replicate their previous trials, so that the results could be directlycompared. Four kinds of chemical protection suit were used: three werethose used in the previous trials, a non-coverall made of PVC, a coverallmade of neoprene, a gas-tight suit made of hyperlon. The fourth suit wasa Chemrel Max `limited use' suit, made of a laminated polymer.

The suits were contaminated, in the sameway, with three of the safe dummy contaminants used in the previous trials:talcum powder, vegetable oil, and golden syrup. Each contaminant containedabout 2% of fluorescein which, even in minute quantities, shows up understrong ultraviolet (UV) light.

The trials procedure was identical to thatof the original trials. Basically, the firefighter was dressed in the chemicalprotective suit, contaminated, viewed under UV light and an audio and photographicrecord made of the degree of contamination. The suit was then decontaminated,and again viewed under UV light where a second record was made.

In all, four trials were undertaken, onewith each suit, in which patches of all three contaminants were appliedto each suit. The positions of the patches were varied from trial to trial,and the decontamination operative did not know where, or how, the suitshad been contaminated at the time of the trials.

The two FEU's seconded fire officers (one6 2" tall, the other 5 7") acted alternately as the contaminated firefighterthroughout, and the system designer's representative did the cleaning.A `special' detergent, stated by the manufacturers to be less harmful than`normal' detergents, was used at a concentration of 3%. The temperatureof the pre-

mix leaving the nozzle was found to be 39oC, and this causedno discomfort for the firefighters. Five minutes was allowed for cleaningin each trial, to be consistent with the previous work.

The results were most encouraging. Withall of the suits, the amount of contaminant left on the suit after theprocess was found to be very small, and significantly less than that leftby any of the methods previously tried, which included those currentlyemployed by brigades.

Also, this `enclosed' system did seem tocontain virtually all of the fog, and all run-off. Some very small amountof fog did escape during the decontamination process, mainly between thebottom of the tent walls and the bund, but it was thought that this leakcould be reduced by some fairly simple means, and the designer has sinceclaimed to have achieved this. In any event, the system as tested goesa long way towards achieving total containment; none of the previouslytried methods, in itself, made any attempt at containment.

No difficulties were experienced with thedecontamination process. It was found that the person being decontaminatedcould easily hear the verbal instructions of the operative, speaking normally,through the tent and suit.

The volume of pre-mix actually used inthe trials was some 19 litres per decontamination, much less than withany other method tried. This, in itself, could be a major advance for brigadessince the National Rivers Authority favour a containment policy for alldecontamination run-off.

All in all, the system and equipment provedvery effective. The manufacturer stressed that the equipment used in thesetrials was a prototype `lash-up', and that the complete system could bepackaged in a number of alternative ways, to assist brigades with any possibleproblems of stowage.

High pressure decontamination in progress

The system, and trials, are fully reportedin FRDG Publication No. 2/95.

Thespraying takes place inside a plastic tent which has transparent windowsand arm length gloves built in. This tent, supported by a collapsible frameworkof aluminium alloy tubes, has entry and exit flaps on opposite sides, eachsealed by a waterproof zip and the whole unit stands inside a plastic bund,about 0.3 metres high. The decontamination operative remains outside thetent at all times.

THE APPLIANCE OF SCIENCE TO FIREFIGHTING

John Foster

Fire Research News 19

Every firefighter develops wide experience of how fires behave and whathappens when water andother extinguishing media are applied to fires.Training provides a valuable supplement tothis experience but there is,at present, a lack of knowledge of the physical and chemicalprocessesinvolved when fires are being extinguished. The Application of SciencetoFire Fighting' is a research theme which has been introduced recentlyto group together aseries of projects to address this area.

The overall emphasis in this work is to try tohelp operational firefightersby giving practical guidance which will help them on thefireground. Whilstsome guidance can be given now, more research is necessary to gain abetterunderstanding of the processes involved in fire suppression and extinction.

The projects covered by this theme are:

- the science of firesuppression andextinction,
- flashover and backdraught,
- venting of large scale fires,
- positive pressure ventilation(PPV),
- firefighting sprays,
- additives for Class A fires.

Most of these projects were identified in the scoping study carriedout by the Home Office Fire Research and Development Group (FRDG) severalyears ago to consider what research mightbe done to assist firefightersin stemming the losses from large fires. The list includesrelatively shortduration practical projects where simple guidelines may result from thework - the best way to deploy PPV fans or the signs that give warning ofbackdraughtsituations. The longer term parts of the work should benefitthe firefighter by improving theunderstanding of the basic science andhelping them become more aware of the critical factorsthey need to bearin mind when on the fireground.

TheScience of FireSuppression and Extinction

How well do we really understand fire suppression and extinction? Thereare many published works on the principles used in the science offiregrowth. The processes of ignition and subsequent fire development are wellunderstoodand documented. Surprisingly however, there is not the samelevel of information on the scienceof extinguishing fires.

The objective of this project is to produce a comprehensivedescriptionof the suppression process from a fully developed fire to the pointofextinction. A three year research agreement has been made with the Universityof Edinburgh by FRDG, and work commenced in August 1994. Dr George Grantis carrying out the research underthe supervision of Dr Dougal Drysdale.Initially a survey of the existing knowledge is underway which will servefour purposes:

to provide a useful source for researchers,

to identify areas where there are gaps in the knowledge which may needaddressing,

to provide useful training material for the fire service, and

possibly to identifyresearch areas for improving firefighting equipmentand tactics.

Flashover and Backdraught

Flashover and backdraught are words that start the warning bells ringingfor firefighters.They need to have a clear understanding of the processesinvolved. It was decided that apreliminary study was required to bringtogether the state of knowledge on the subject andidentify any need forfurther work.

In Issue 17, we reported the results of the survey of backdraught undertakenon behalf of the Home Office by the Fire Research Station. The surveyconcludedthat, although more research into backdraught might prove useful, mostof theprocesses involved were well understood by the fire scientists.The major problem appeared tobe a lack of effective communication betweenthe fire scientist and parts of the fire service.Firefighters were notbeing given the benefit of the knowledge that was available.

To address this problem area a supplement to the Manual of Firemanship has been recentlypublished entitled: "The Behaviour of Fire - CompartmentFires". This is now available fromHMSO priced £3.50.

The supplement summarises, without goinginto theory, what is understoodabout the early stages in the growth of a compartment fire andconsidersbackdraught, flashover and the effect of ventilation. It also describesthe signsand symptoms firefighters should check for before opening thedoor to a compartment, and someof the actions that can be taken by firefightersto prevent, delay or reduce the effects ofthese events.

The original project has now been completed but a new project hasarisenfrom this work. It is planned to develop a compartment fire simulator todemonstrateflashover, backdraught and other related events using realisticsources of fire. It isanticipated that the effects of fire fighting tacticssuch as venting could also be shown.

The compartment represents a room at half-scale and will initially beused to provide footage for a training video on all aspects of fire incompartments. The further developmentof a full-scale version will thenbe assessed.

Ventingof Large Scale Fires

The cry from the fire service in the USA is "vent early and vent often".This is not the approach of the United Kingdom fire service and, to findout more, a survey of ventilation was initiated. The survey was undertakenon behalf of the Home Office byWarrington Fire Research Consultants andthis was reported in Issue 17. The consultants feltthat there was scopefor the more extensive application of ventilation tactics in the UK.Theyconsidered that there was a need for further research, aimed atassessingthe effectiveness of various tactics and developing safe working practices.

The advantages of effective ventilation claimed for the firefighterare:

removal of the hot products of combustion,

reduction of fire spread,

improvement of visibility.

There are also reservations about using ventilation because, in some conditions,it may resultin an increase (not a reduction) in fire spread, and so endangerfirefighters. What is neededis guidance to help the Officer-in-Chargeto make the right decision.

A further programmeof work is now being carried out by the Home Office,which makes use of computer modelling toundertake a theoretical exploration- backed up by large scale practical tests - of the effects of tacticalventilation in a number of scenarios. Modelling is being carried outundercontract to FRDG by AEA Technology Ltd, based at Harwell.

The hope is that theeffects of various tactical options can be predictedusing computer models without the needfor expensive and time consumingfire tests. However, it must be shown that computer modellingaccuratelyreflects the behaviour of real fires if the results are to be of practicaluse. Toenable comparisons, a series of validation test fires is proposedin the Industrial B'building at the Fire Service College. This buildingis fitted with roof vents, and tests willbe carried out during which differentcombinations of door and roof vents will be opened. Theinitial tests willuse heptane tray fires which will not allow fire spread to be explored.The building will be instrumented to obtain measurements that will includetemperatures and gasflowrates through the vents or doors and the testresults will be compared with the computerpredictions.

If the modelling proves to be reasonably accurate then the modellingof fire spread will have to be assessed. Once the computer model has beenused to develop practicalguidelines these will be subjected to exhaustivelarge-scale tests.

A computer representation of the Fire College Industrial B Complex

PositivePressureVentilation

The newest tactic to be promoted from across the Atlantic isPositivePressure Ventilation. This was considered in the survey of ventilationand is anarea generating much interest in brigades. There are an increasingnumber of PPV fans on therun' in the United Kingdom and favourable reportsare being received from their use atoperational incidents.

The Fire Experimental Unit (FEU) is looking at the use of PPV in a domestichouse and in a basement fitted with pavement lights. The main aim of thework is toassess whether the tactical use of PPV fans, during firefighting,offers a significantimprovement over natural ventilation, smoke extractionfans or the use of sprays for removingthe products of combustion in smallfires.

Fire tests are planned in the DomesticBuilding' on the Fire ServiceCollege fireground but, before these fire tests are carried out,experimentsare under way in a wooden mock up

that has been built in the FEU'sstill-airfacility, to simulate one of the rooms in the Domestic Building. Here,accuratemeasurements of air flow can be made in a wind-free environmentso that the optimum positionfor siting the fan can be determined and theeffects of different sizes of openings explored.

The real test will be with a fire in the Domestic Building, and withwhateverthe wind conditions may be on the test day. This more closelyrepresents the operational situation which would be encountered by brigadeson the fireground. These tests are planned for mid-1995 and special instrumentsto measure the airflows in the hot conditions will beused, with speciallycooled obscuration meters and colour television cameras so that themixingand movement of the smoke layer inside the fire compartment can be observed.

A short series of tests was carried out in the basement of IndustrialB' building in April1995 to assess the effect of PPV in conjunction withpavement lights in realistic firesituations.

Firefighting Sprays

All firefighters can tell you the best jet/spray or hosereel branchthey have used. But how do these perform when compared with the latestdevelopments in fogs and sprays introducedprimarily as alternatives tohalon in fixed protection systems? This project aims to obtainexperimentalinformation about the effectiveness of sprays and fogs for use by the fireservice. This work will complement the theoretical study being carriedout by the University of Edinburgh.

Firefighting fogs can prove effective in suppressing compartment firesbut doubts have been cast about their use in well-ventilated areas.

Tests havebeen carried out by the FEU against wooden cribs and heptanetray fires using variouscommercially available fog nozzles operating ata range of nozzle pressures from 250 Bar to7 Bar. Some of the nozzleswere mounted on the end of a lance because they produced lowvelocity dropletswhich could not otherwise reach the fire.

An IFEX Impulse water gun,which projects bursts of about 1 litre ofwater, was also tested and the results are reportedin this issue of Fire Research News.

None of the systems testedwere able to extinguish the heptane firealthough some of the low velocity spray heads didsuppress the flames tosome extent. Much higher application rates may have proved successfulbutcould not be tried in the time available. The crib fires were extinguishedby all of thesystems, and the results were compared with those of a hosereelbranch. All used a similaramount of water to extinguish the fire, butthe hosereel achieved the fastest extinctionbecause of its higher flowrate.

For practical firefighting in well-ventilated areas, the fog systemsdid not show any advantages over the hosereel. Further tests are plannedin the FEU fire test room when a standard fire has been developed whichis more typical of thoseexperienced in a domestic house.

Additivesfor Class A' Fires

Once again, developmentsin the USA have resulted in a new generationof additives now being marketed. The Chief andAssistant Chief Fire OfficersAssociation have reported that they are being approached bymanufacturersoffering additives for use in Class A fires and claiming that theyperformbetter than products previously tested. Work was done by the FEU aboutten years ago,but further work is now required with the latest additivesto compare performance.

TheFEU have identified six new products but it is possible that othersmay come to light. Testfires are planned with a pile of sixty wooden pallets- a fire load double that used in theearlier tests. The first stage willbe a preliminary assessment to determine whether any of theadditives showany significant improvement over the use of water alone.

Future Progress

Progress on all these projects will be reported in future editions ofFireResearch News. The firefighter should have the benefit of the bestinformation available toassist on the fireground and it is hoped thatthis research theme, both in the short and longerterm, will benefit thefirefighter in three important ways:

by providing practicalguidance for use of the fireground,

by providing a better understanding of the importantprocesses involved,and

by making the results available to the fire service in a formthat istechnically correct, but easily communicated and understood.

DOMESTIC FIRST AID FIREFIGHTING

Cath Reynolds

Fire Research News 19

INTRODUCTION

Standard advice from fire brigades and the Home Office is that in the event of fire,the public should evacuate buildings as quickly as possible and call the fire brigade to dealwith the fire. Yet surveys of householders have revealed that the fire service is called toonly one in ten of domestic fires. So why were people ignoring Home Office advice, and whathappened when they did so?

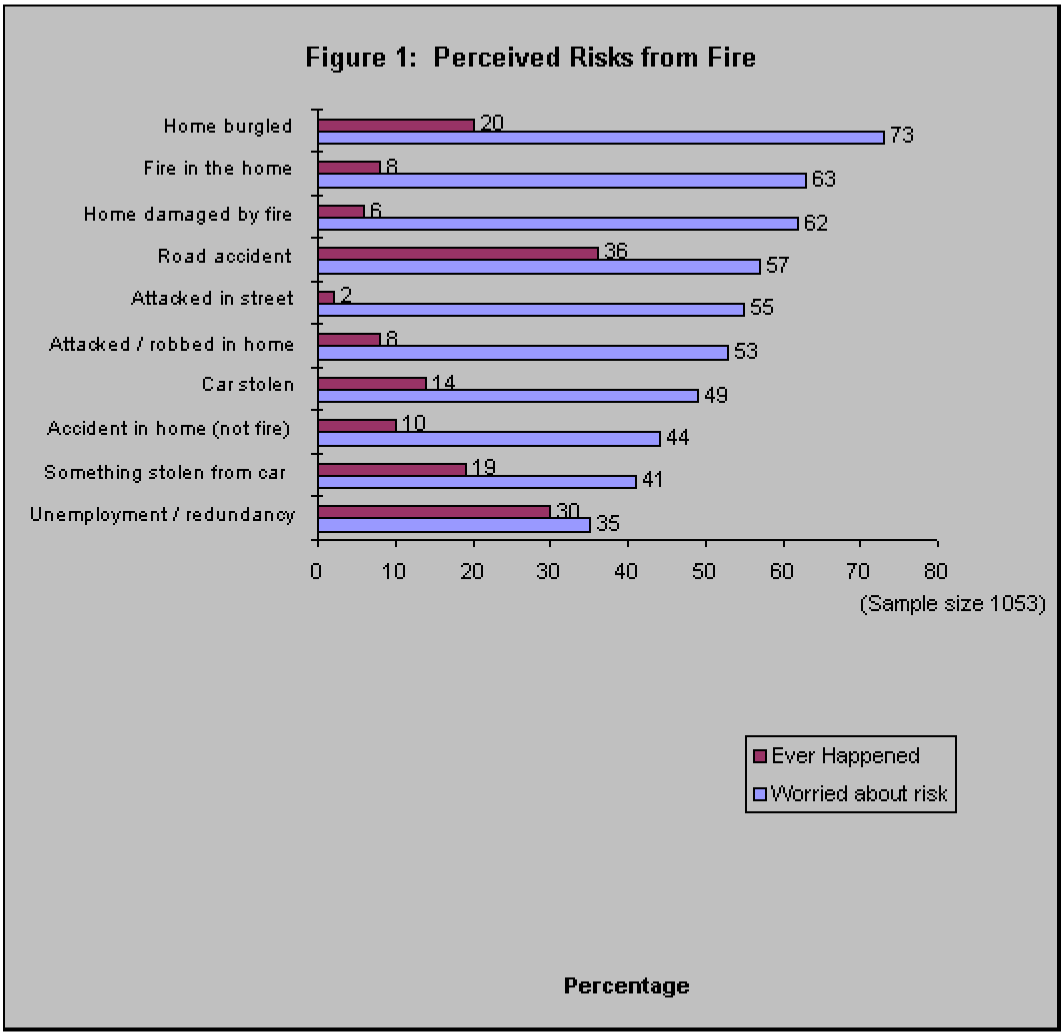
To answer these questions, two surveys of public perception and actual experience of domesticfires were carried out for the Home Office by the pollsters MORI. The first, the `General PublicSurvey', involved approximately 1000 people chosen to be representative of the generalpopulation. The second, the `Experienced Fire Survey', involved approximately 450 people who hadexperienced a fire in the home in the last five years. Both surveys were conducted by fieldworkers completing a questionnaire whilst talking to the respondents in their homes.

General Public Survey

This survey involvedapproximately 1000 people and aimed to gauge their perceptions of the dangers of fire. The questionnaire consisted of over 70 questions on topics such as the perception of danger, firesafety measures, perceptions of ignition, and training and information on firefighting.

Perceived Risks

The results of this survey indicated that whilst domesticfires were relatively uncommon, the risk from fire was apparent to many people. Figure 1 showsthat a fire in the home is high on the list of concern of those in the sample, although theiractual experience of such an event was limited.



Fire Safety Equipment

As a consequence of the perceived risk of fire, andalso of recent advertising campaigns, many domestic dwellings now contain fire safety equipment.

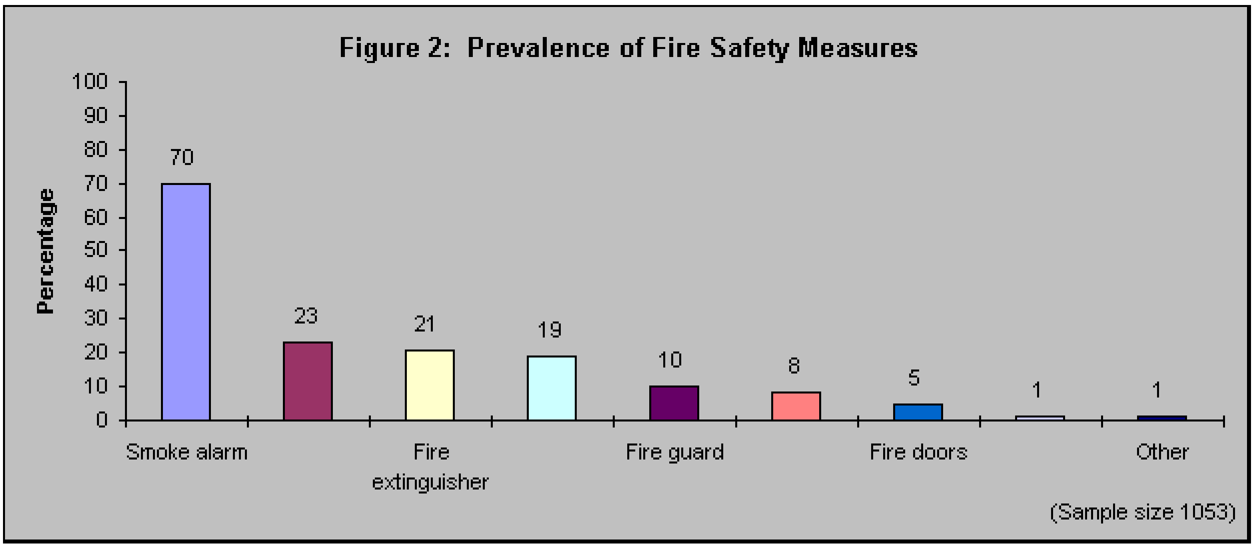
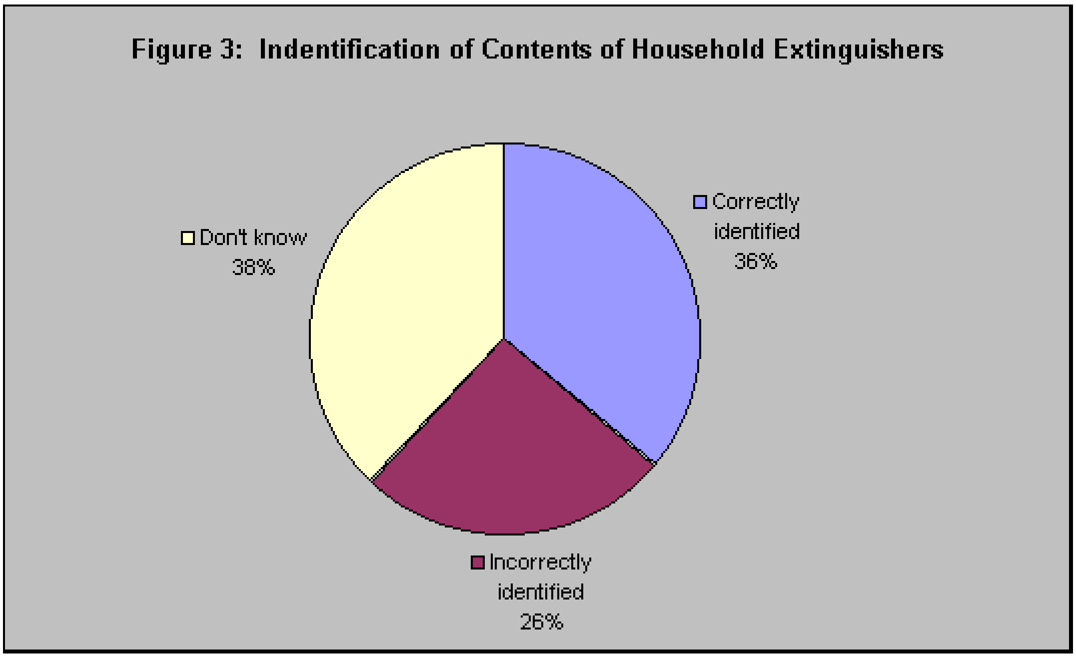


Figure 2 shows that, according to the survey, by far the most common fire safety equipment inthe home is a smoke alarm (70% of households), which is consistent with other recent surveys onsmoke alarm ownership. Twenty three percent of households had planned their escape routes andownership of fire extinguishers and fire blankets stood at 21% and 8% respectively. Clearly, thepublicity campaigns for smoke alarms have been very successful.

The majority of householdsnow have some form of fire safety equipment, although knowledge about how to use it in the eventof a fire is often incomplete.

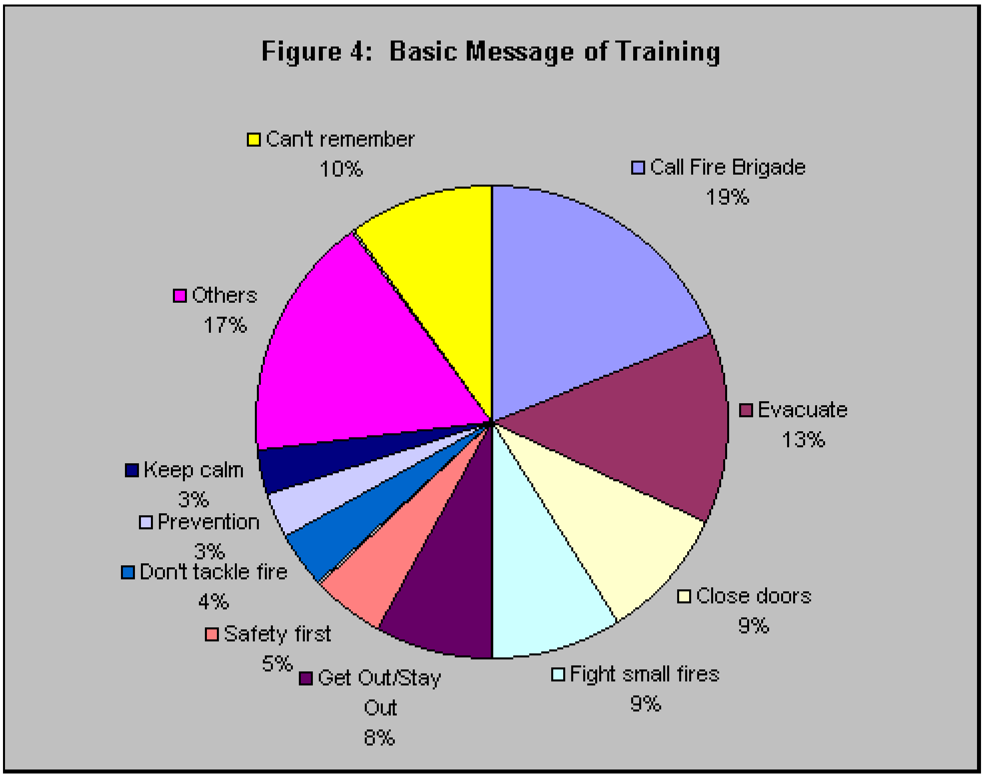
Thirty-eight of those surveyed who owned a fire extinguisher did not know what their fire extinguisher contained and many were unsure about which type ofextinguisher was suitable for a particular type of fire. Figure 3 indicates the percentage ofthose questioned who could correctly identify the contents of their extinguishers.



On the basis of the surveys, two courses ofaction suggest themselves: either to promote dry powder extinguishers on the basis of their good all-round performance, but to emphasise their limitations, or to provide more information onthe various types of extinguisher available and their suitability for different types of fire.

Training

Only 18% of those surveyed said that they had received trainingon how to deal with a fire, and 62% were unaware of advice given by the Home Office and firebrigades which is "Get out, call the fire brigade out and stay out". Figure 4 shows the basic, overall message that those who had been trained remembered from their training variedconsiderably. This suggests that a more consistent message should be promoted in training.



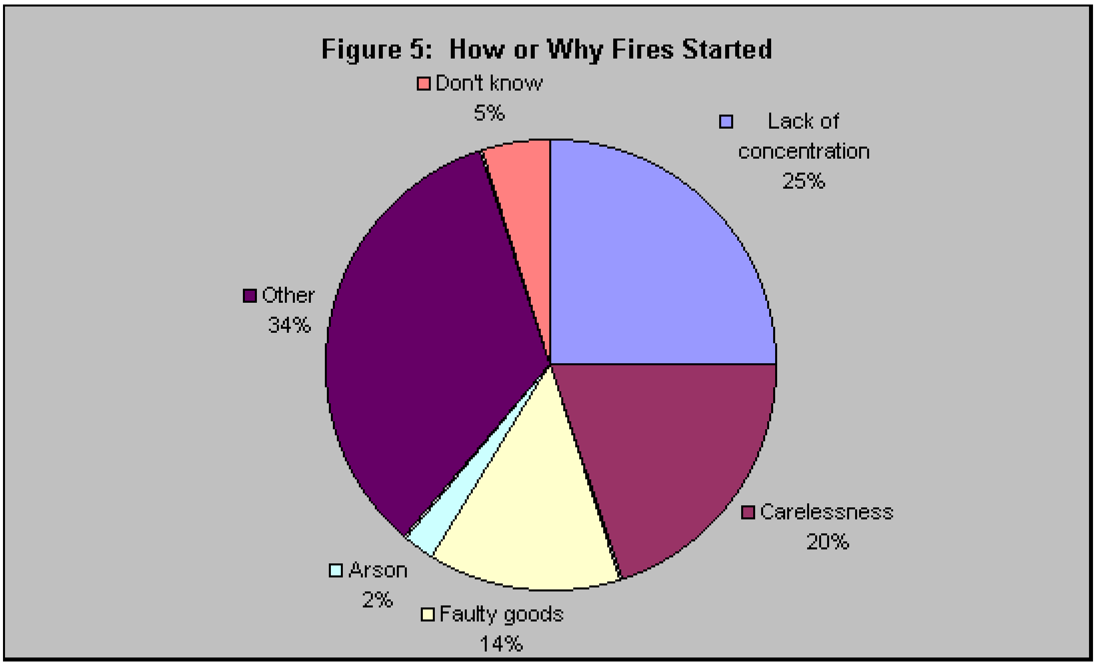
In view of the low percentage of thosetrained, consideration might be given to increasing the emphasis on training and clarifying the basic message.

"Experienced Fire" Survey

The second surveyinvolved approximately 450 people who had experienced a fire in the home in the last five years.They were asked to complete the same questionnaire as the general public survey, followed by anadditional questionnaire which requested information on such things as, how the fire started,whether anyone fought it, whether the fire brigade was called and whether the experience hadprompted a change in their domestic arrangements.

How Fires Started

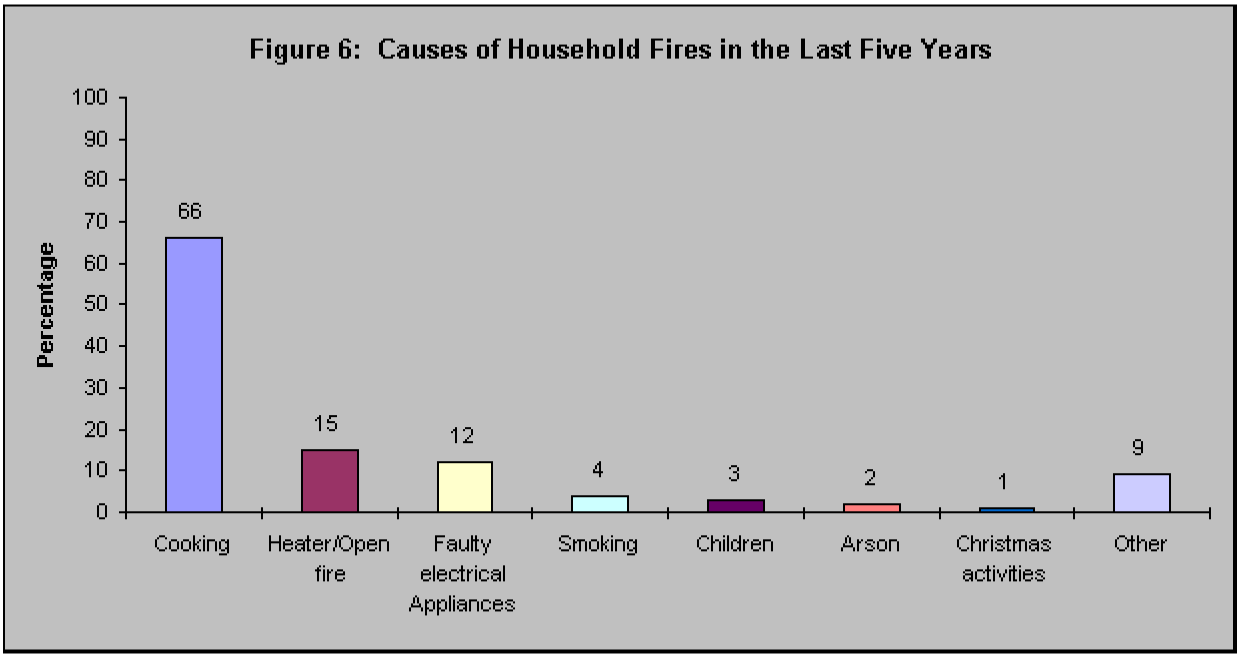
The results showed that one quarter of those questioned cited "Lack of concentration" as the initial cause of the fire, with a further 20% suggesting that carelessness was to blame. Manyof those questioned cited diverse "Other" reasons as the cause of the fire which did not fitinto one of the main categories, shown in Figure 5.



These findings suggest that more advice onhow fires can start through distractions and carelessness is required.

Causes of Fire

The majority (66%) of the fires in the survey involved cooking. Figure 6 displays the causesof the fires which had taken place in the homes of those questioned.

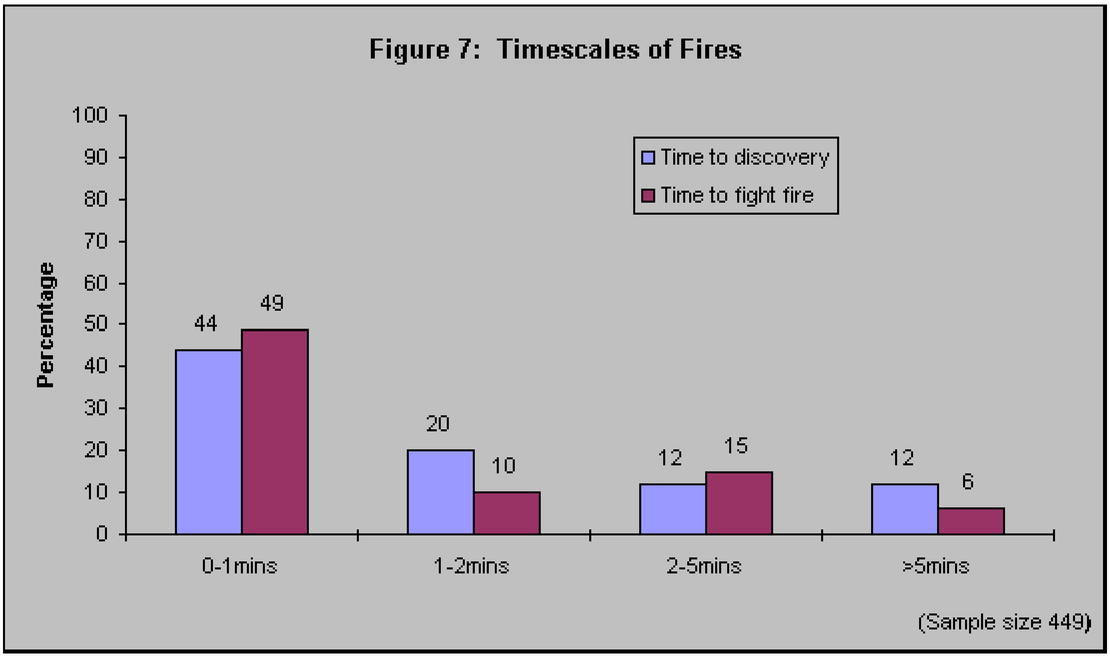


This suggests that there is still a need for more fire safety publicity education on cooking fires.

Timescales of Fires

The majority (69%) of those who tackled the fire did something straight away, withoutstopping

to think about how best to respond to the situation. The majority of fires (53%) hadbeen discovered within about a minute of starting and the average time to fight a fire was 2.5minutes (Figure 7).



It appears that indomestic situations many fires are discovered shortly after ignition and can be extinguishedquickly if the firefighting response commences immediately upon discovery. However, the need forvirtually immediate action does not give much time to decide what to do if an appropriateresponse does not suggest itself, as a result of previous guidance or prior thought.

Firefighting - Attitudes

Eighty percent of those who had experienced afire did not call the fire brigade but tried to put it out themselves. Ten percent more men thanwomen said they would tackle a fire.

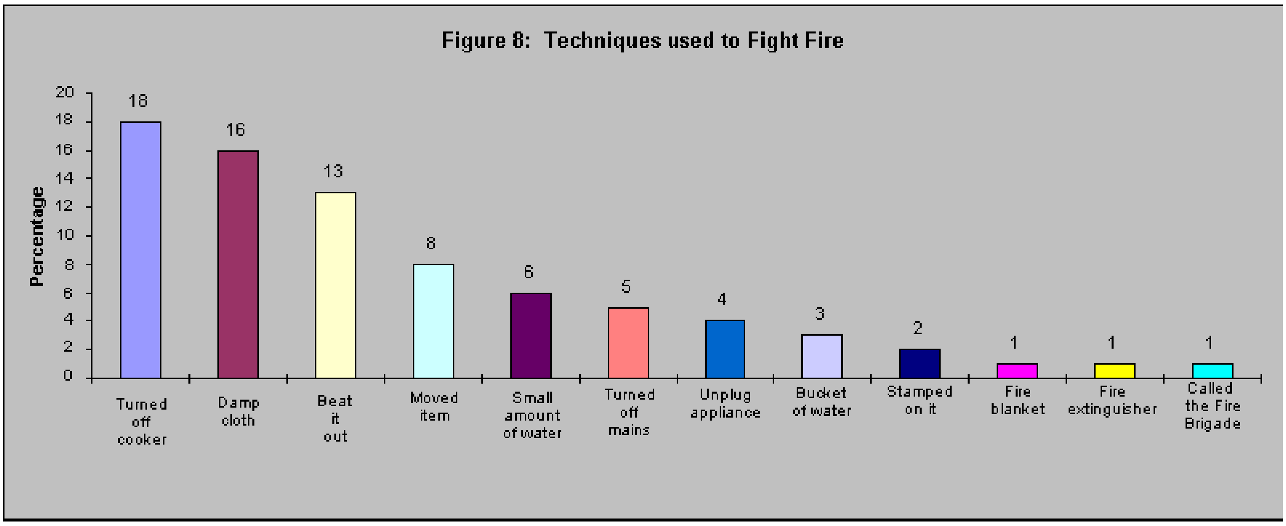
The two most common initial actions were turning off the source of the heat (19%) and fighting the fire with a damp cloth (16%). However, 8% saidthat they moved the item on fire, despite the fact that moving a burning object can be extremelydangerous.

Fires involving electrical appliances caused the greatest concern when firstdiscovered. They were also more likely to produce lots of smoke and to result in damage to property.

Seventy three percent of the fires in this survey had flames less than onefoot high at worst and 81% of those questioned described the fire as "Small and easy to put out", indicating that most people will try to fight fires they perceive as being relatively minor.

Firefighting - Techniques and Equipment

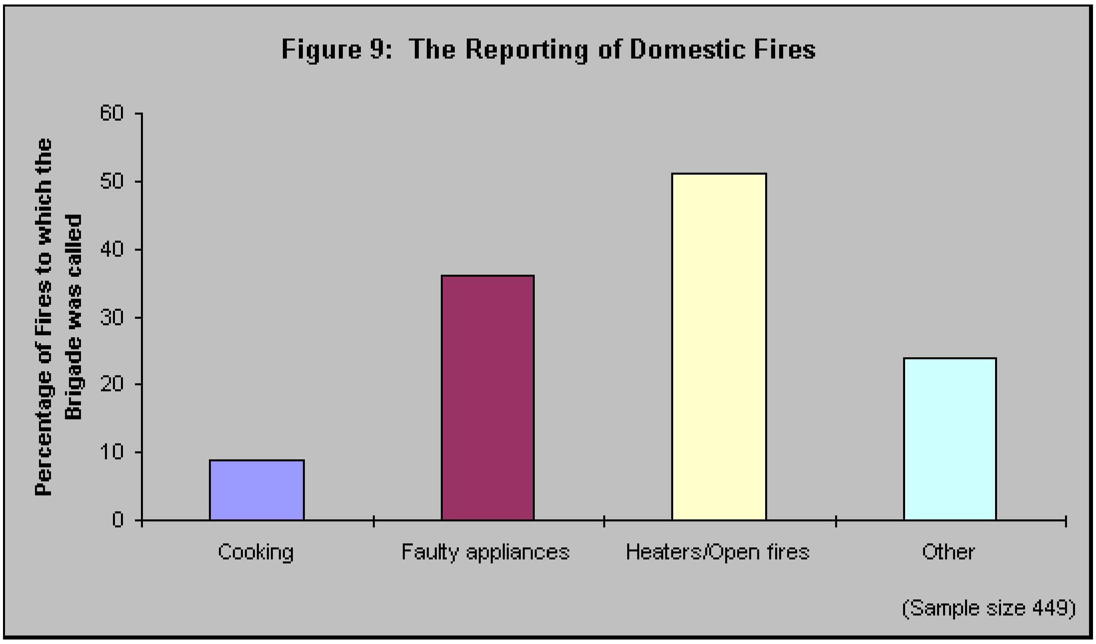
A range of items were used whilst tackling the fire. The most commonly used item was a damp cloth (15%), 9% said they had beaten out the fire, 6% said they had used a small container of water and 3% a bucket of water. Few mentioned using a fire blanket (1%) or a fire extinguisher(1%). Figure 8 provides details of the most common firefighting techniques and equipment.



Most fires were extinguished using a damp cloth or water, and few people used a fireextinguisher or fire blanket, suggesting that using items readily to hand was a more instinctivereaction than using specific firefighting equipment.

Reporting of Fires

The fire brigade was called to only 19% of the fires experienced, but this seemed to bedependent upon the type of fire. Figure 9 shows that only 9% of cooking fires were reported,whilst the fire brigade were called to 51% of fires caused by heaters/open fires.



This suggests that people are less likely to fight fire involving electrical equipment and open fires and consideration should be given toproviding more information on how best to deal with these types of fire.

Consequences of Fire

Six out of ten people reported that since the fire they had become more aware of the danger of fire and had changed their domestic arrangementsaccordingly; for example, by unplugging electrical appliances that were not in use and buyingsmoke alarms (Figure 10). Many people had made minor "Other" changes to their home or lifestylewhich they felt also contributed to increased fire safety.

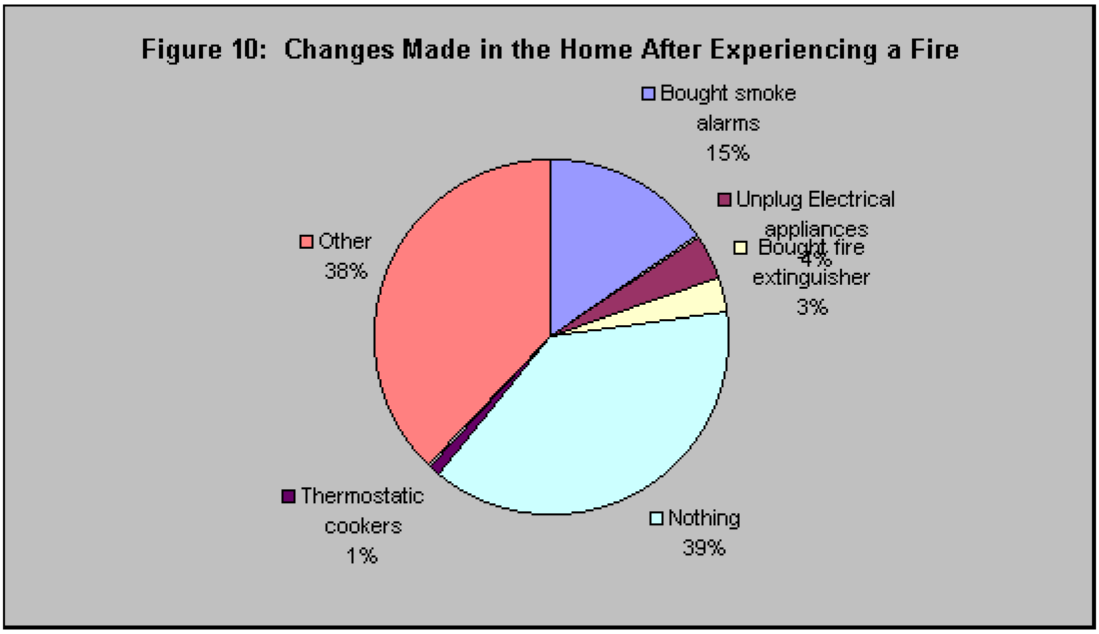


Figure 10

In the course of fighting the fire, almostsix in ten felt either calm or in control and the majority had put the fire out in an estimatedtwo minutes. Only 3% said that their efforts had made the fire worse and only 5% of the fires had led to any kind of personal injury.

Overall, three quarters (74%) said that the fire was quickly extinguished. Twenty eight percent of the fires caused damage to propertyestimated at greater than £50.

Publicity and Education

Over 70% of all questioned remembered seeing or hearing information about fires in the home.Most of these were from television, but others also mentioned newspapers, leaflets and firebrigade visits. Almost 90% still said that they would like more information on dealing withfires, the majority suggesting television as the most suitable medium.

So What's the Use of All This?

In the light of these findings, the Home Office Fire Safety Division is considering reviewingthe information given to the public on how to deal with fire in the home, so that it may be possible to provide more specific information similar to that given for tackling chip pan fires.

REVIEW OF THE BSI FIRE SAFETY ENGINEERING CODE OF PRACTICE

David Lillicrap

Fire Research News 19

Introduction

The vast majority of fire safety measures taken in the UK have beenthe result of the experience of serious fires stretching back to the GreatFire of London. This evolutionary approach has produced a high level ofsafety. However, it limits the use of many modern techniques in engineeringand architecture, together with the benefits new materials can provide,and it does not easily recognise measures which have become ineffectiveand outmoded.

At present, in order to apply innovative techniques and use new materials,designers must make assessments of the fire safety of premises using informationabout fire loading, risk of fire, behaviour of potential fires, behaviourof people escaping and the effect of firefighting. No agreed standardsexist that define how this assessment should be made. To overcome the inconsistenciescaused by the current approach to fire engineering, the British StandardInstitute (BSI) has prepared a draft document - `British Standard Codeof Practice for The Application of Fire Safety Principles to Fire Safetyin Buildings'. BSI made the draft available for review in 1994, and thisarticle summarises the Home Office's involvement in the review process.

In brief the code of practice intends to provide a standard way forbuilding designers to depart from traditional fire safety concepts, providingthey can demonstrate that the building will still achieve an acceptablelevel of fire safety.**The Analysis of The Code**

A working party looked at each section in detail, examining the methodand structure of the proposed processes; analysing the scientific and mathematicalcontent to ensure its accuracy and co-ordinating the contribution of expertsin various fields. The completed review was sent to the BSI in November1994. The main conclusion was that, while the Code of Practice was potentiallya useful document, the current version failed to address adequately manyof the problems encountered when using fire engineering in building design.

The Worked Example

During the review process it became evident that, to properly supportthe review of the draft Code of Practice, it would be necessary to applythe code to a real life situation. Having identified building plans thatwould be suitable for the application of fire safety engineering principles,the Loss Prevention Council was contracted to undertake the exercise ofusing the draft code.

An early decision had to be faced was whether to follow the processdefined by the Code of Practice, or to adapt it to make it more useful.It was decided to follow the defined process to enhance the validity ofthe worked examples, but to depart if the defined process made progressimpossible. The Code of Practice defines the following basic stages:

a) Define the problem.

b) Analyze the problem using fire safety engineering principles.

c) Repeat stages a and b until an acceptable solution is found.

d) Report the findings.

The Code of Practice calls the stage involving defining the problemthe `Qualitative Design Review' (QDR). When the QDR comes to an end thefollowing questions must have been answered:

- what level of fire safety is acceptable,
- what are the precise features and dimensions of the building,
- what factors limit possible solutions ,
- what are the main hazards and consequences,
- what fire safety measures are going to be in place,
- what scenarios are going to be studied, and finally
- what method of analysis is going to be used.

When all these questions have been answered the analysis of the buildingcan begin.

For the analysis phase, the Code of Practice provides two alternativeways of analyzing the building. The first method relies on probabilitiesto determine the likelihood of death or injury. The second method usescomplex calculations that describe the properties of fire, to determinewhether occupants can escape safely. To enable a complete understandingof the Code of Practice it was decided that both forms of analysis wouldbe required.

The results of the project should be available this year.**Conclusion**

The Home Office review, together with the results from the trial applicationof the Code of Practice should provide a very clear assessment of the Codeof Practice, which will help ensure that a potentially valuable tool isused responsibly.

DRY POWDER PYROTECHNIC GRENADES

Martin Thomas

Fire Research News 19

At the turn of the year, a number of manufacturers were offering pyrotechnicdevices which, once ignited, generate large amounts of dry powder extinguishant.These devices were originally developed in Russia, primarily as a fixedsystem, and are now being proposed as alternatives to Halon 1301 systemsas the Montreal Protocol starts to take effect. Some Russian brigades arebelieved to be using them operationally as grenades to be thrown into compartmentfires.

The devices contain a conventional fuel/oxidiser mixture designed toburn at a controlled rate, producing a very fine dry powder with a particlesize of typically one micron (a water mist has an average droplet sizeof typically 200 microns). They are initiated either electrically or bylighting a fuse. A cartridge weighing 4.5 kg generates 3 kg of dry powder,and can extinguish a fire in a sealed 28 cubic metre compartment.

This sounds most impressive, but brigades should be aware of the system'slimitations:

- The particle size is such that it canbe inhaled into the lungs, where its effect would depend on its chemicalconstitution. The extinguisher could not be activated therefore until everyonehad been evacuated, and it would also have to be assumed that sufficientpowder would remain as deposits in the compartment once the fire had beenextinguished to present a similar hazard during clearing up.
- The particle size has been selectedto permit it to remain in suspension in air, producing an inert environment.If the compartment is ventilated, powder in suspension in the air willbe drawn out.
- Dry powder can suppress Class A fires,but does not cool the fuel. When dry powder is used to extinguish a deep-seatedfire, the fire would re-ignite as soon as fresh air reached it, unlessthere had been sufficient time for the fuel to cool as the compartmentcooled.
- The device generates flame and heatduring discharge, and could ignite a flammable atmosphere before the powderconcentration was sufficient to inert the atmosphere.
- The device would be classified as anexplosive because, although designed to burn at a constant rate under normalconditions, it could explode if discharged inside a sealed container, orif the charge was cracked, increasing the surface area and changing theburning rate.

There are certain scenarios where such devices would be suitable butthese do not include Class A fires or where equipment might be damagedby a fine powder deposit. Its use in manned areas would have to be questioned,because of the high obscuration levels and possible toxicological risksdue to inhalation.

THE FIREFIGHTING PERFORMANCE OF THE IFEX WATERGUN

Bryan Johnson

Fire Research News 19

Water mist systems are being used increasingly in fixed firefightinginstallations as they have been found to be effective in suppressing firesin closed compartments.

The Fire Experimental Unit (FEU) has been trying out several variationsof these systems to see how effective they are at extinguishing fires thatare out in the open where the air supply is not limited. The aim of thiswork is to see if the technology could be developed for use operationallyby the fire service.

During the course of this work the IFEX water gun has been tested. Thishas been designed for use by firefighters rather than in fixed installations.The gun is hand held and fires 1 litre bursts of water, using compressedair, at a rate of around 1 burst every two seconds.

Two series of fire tests have been carried out where the firefightingperformance of the IFEX gun has been compared with that of a conventionalhigh pressure hosereel branch. One series of tests involved Class A firesin standard wooden cribs, while the other series involved fires in thepassenger compartments of cars.

Both the IFEX gun and the hosereel branch extinguished the wooden cribfires using around 40 litres of water. However, the hosereel branch wasoperated at 100 litres per minute and so it extinguished the fire in amuch faster time.

The car fires produced a similar story: both the IFEX gun and the hosereelbranch used comparable quantities of water to extinguish the fires, around20 litres this time, and again the hosereel branch was much quicker.

The capacity of the water tank feeding the IFEX gun varies dependingon the system required. The system in use during FEU's tests contained50 litres of water which was fed to the gun via 25 metres of hosereel.This limitation in water supply meant that damping down to prevent reignitionafter both sets of fires required the use of a hosereel branch. Also, duringone of the car fires, flames continued to burn in a virtually inaccessiblearea behind the dashboard after the IFEX water supply had been exhausted.Consequently, a hosereel branch had to be used to complete the extinction.Other IFEX water gun systems are available: one system involves a standalone' backpack which has a water tank with a capacity of 10 litres, whileanother is a hosereel system that can be mounted on to an appliance andreceives its water supply from the appliance tank via the main pump.

These fire tests indicate that the IFEX water gun uses similar amountsof water to a hosereel branch to extinguish Class A and car fires. However,should problems occur during the extinction of such fires, the water supplymay be insufficient to cope. Operations where speed of extinction is important,or where copious amounts of water are required, are better tackled usingconventional equipment, if it is available. The IFEX water gun may

findapplication in areas such as quick response vehicles in which space isat a premium and a limited but effective fire fighting system is requiredto tackle fires, pending the arrival of conventional fire fighting equipment.

Further fire tests are planned towards the end of the year. These willinvolve realistic domestic room fires and will again compare the performanceof the IFEX water gun with a hosereel branch.

FIRST AID FIRE FIGHTING

Kirsty Bosley

Fire Research News 19

A dense smoke layer has formed above the burning sofa bed

The 1988 British Crime Survey reported that only one in ten fires inthe home are reported to the fire brigade. So what happens to the othernine? The answer must be that they are fought by householders. This raisesfurther questions. How do they fight the fires? Is it the best and safestway? Can they get better advice on early firefighting?

The Home Office Fire Research and Development Group (FRDG) looked atthis problem from two angles:

- To find out what people have donewhen they have had a fire in their home.
- To try and find the best way for themto tackle fires.

The project started with two surveys. One asked members of the public howthey might react to a fire, the other asked people who had experienceda fire what they did. The results of these two surveys are reported inthe article in this issue by Cath Reynolds.

While the surveys were going on, a series of fire tests were held totry out various methods of firefighting. The tests were simplified versionsof typical domestic fire scenarios. They were grouped into categories representing:

Chip pans

Waste bins

Clothes horses

Furniture

Electrical appliances

It was essential that the tests were the same, so that the firefightingtechniques could be compared. However, the way the fires might spread wasnot considered as part of this study.

The methods of firefighting that could be used depended on the typeof fire. The main methods were either to throw water at it or to smotherthe fire. Water was used in various amounts, either a cup, jug, or bucketful.Tea cloths and towels were used for smothering. The towel was also usedfor beating out some fire types. A fire blanket and dry powder extinguisherwere also used.

Some of the conclusions of this work may seem obvious, but others aremore surprising. For most categories of fire, other than hot fat or electricalfires, throwing water at it was found to be the quickest and cheapest wayto put it out. A cup of water, thrown on early, was more effective thana jugful applied later, when the fire had grown. Even if it didn't putout the fire completely, the fire was usually reduced or controlled enoughto allow the householder to carry out further, safer firefighting.

For chip pan fires, the standard advice, to use a damp tea cloth, provedto be the most effective method. It didn't always put the fire out completely,but it reduced the flames to a size that made it easy to put on anotherdamp tea cloth.

Smothering other fires with a cloth wasn't always successful; at timesthe cloth became involved in the fire and created a worse fire. The fireoften smouldered on under the cloth so that when the cloth was taken off,the fire reignited. Smothering was far more effective with a wet cloththan a dry one.

Where it was possible, the fire was beaten out with a folded hand towel.It worked, but could be daunting for an inexperienced person.

The performance of the fire blanket used in these tests was disappointing.It was too big to use easily and too stiff to drape over the smaller fires.On the chip pan fire for example, it didn't seal off the fire, which continuedto burn. A different type of fire blanket may have performed better.

The dry powder extinguisher on the other hand, easily put out firesof all types. The disadvantages of using dry powder, particularly on smallfires, are the mess and expense and, of course, it can pose problems witha chip pan fire. Where electrical equipment was well alight, a dry powderextinguisher was often the only reliable way to tackle the fire.

Bearing in mind the amount of fires tackled by householders, this worksuggests that a dry powder extinguisher could be a valuable asset in thehome.

In the absence of an extinguisher, people are likely to use somethingclose to hand. A wet tea cloth on a chip pan is ideal. Except for fat orelectrical fires, a cup of water is often the best way to start firefighting.

THEEFFECTIVENESS AND SAFETY OF FIRE HOODS

Fire Research News 19

Which camp are you in? The fire hood protagonists- who consider that firefighters are only properly protected if they arewearing firehoods to cover their ears. Or the antagonists - who recommendleaving the ears exposed as vital temperature sensing devices.

The Home Office Fire Research and DevelopmentGroup tasked the Institute of Occupational Medicine (IOM), Edinburgh, toundertake a study to investigate whether there are any inherent dangersfor firefighters wearing either close fitting balaclavas or general purposebalaclavas, as compared with the specification E9 anti-flash hood.

They aim to answer questions such as whetherthe wearing of balaclava hoods for long periods could lead to heat stress,and whether their use could result in firefighters becoming less sensitiveto increases in temperature - so inducing a false sense of security leadingthem to remain in potentially life threatening situations.

First Phase of the Study (data gathering)

The first phase of the study was carriedout as an integral part of the project: A Study of the Degree of ProtectionAfforded by Firefighters's Clothing (see Fire Research News Issue 16) whichwas already under way. This involved:

- Adding sections relating to fire hoods toboth the firefighter and brigade clothing questionnaires sent to all UnitedKingdom brigades.
- The addition of head and neck regions to thebody maps when designing the injury report forms. Standard forms (44C,FRD1 and HSE F2508) could not be used as they did not contain sufficientdetails either of injuries sustained or the protective clothing worn. Theforms were distributed to all operational firefighters, who sustained injurieswhilst wearing protective clothing, until a target of 800 returns was reached.This was achieved in March 1995.

Analysis of the data yielded the requiredinformation concerning the variety of protective hoods worn, how and whenthey are used, and the type of injuries sustained during operational dutiesin the period March 1993 to March 1994. The information obtained has beenof great value during the development of the various aspects of the secondphase of the study.

Figure 1 : Home Office specification E9 anti-flash hood is a loose-fitting,curtain-type hood, designed to fit quickly and easily over a firefighter'shelmet and breathing apparatus. In 1984, brigades were advised thatthis provided the best form of protection in **foreseen flashover conditions**because of the air space between the hood and wearer. Relativelyfew firefighters have had experience of wearing anti-flash hoods, and somebrigades no longer supply them.

Second Phase of the Study (practical aspects)

Manufacturers of close and/or loose fittingfire hoods were contacted, and examples of their protective hoods wereobtained and subjected to:

- Three sets of tests at the IOM laboratoryin Edinburgh:

Treadmill Tests which involvedfirefighters exercising in a climatic chamber (maintained at 30^{o}C)in order to determine the impact of wearing fire hoods with regard to thermalstrain.

Audiometric Tests to investigateany decrement in hearing ability of firefighters whilst wearing fire hoods;including the ability to locate sound.

Physical Tests carried out accordingto BS 3791 in order to determine heat protection. Before the tests wereconducted, the material tension for each hood, fitted on a manikin head,was set to simulate tension during wear.

- Wearer trials including ease of donning andremoval of protective hoods. These were undertaken by candidates (fireofficers, firefighters and recruits) attending standard brigade trainingcourses at Greater Manchester, Kent, Lancashire, Surrey and Wiltshire FireBrigade Training Centres an the Scottish Fire Brigades Training Centreat Gullane.
- An observational study, undertaken at theRoyal Berkshire Training Centre, Whitley Wood, aimed at investigating anyinfluence of fire hoods on working practices. Fifty five firefighters (fromBuckinghamshire, Hampshire, Oxfordshire and South Glamorgan Fire Brigades)undertook a realistic exercise whilst wearing fire kit with or withoutfire hoods.

Figure 2 : General purpose and close fittingbalaclavas are typically known as fire hoods but they are not manufacturedto a particular specification. Many firefighters have had operationsexperience of wearing these fire hoods as they are becoming increasinglypopular as an item on personal issue.

Extension to Second Phase

On commencing the study it became apparentthat some brigades regarded helmet skirts, offered by all `new generation'helmet manufacturers, as an alternative to fire hoods. Therefore, in February1994, it was decided to extend the work in order to investigate:

- The possible interaction of the helmet skirtwith fire hoods.
- The possibility that such skirts could funnelheat up into the helmet.
- The Gallet helmet system which is currentlybeing trialled by some brigades and is even more enclosing and potentiallyinsulating than more conventional skirts and hoods.

Figure 3 : There are two types of helmet skirt, (a) shortskirts which do not reach the shoulders and (b) long skirts which reachdown to the shoulders. Both can be rolled up into helmet shell when notin use.

The helmet skirt is an accessory offered by all 'new generation' helmetmanufacturers

Figure 4 : The external shell of the helmet is designedto cover the ears and neck thus reducing the need for any additional protectionfor the neck, ears and side of the face.

This helmet has a protection system incorporating both an eye screenand a gold coloured reflective face shield. Either may be controlled,i.e. lowered into position then raised and withdrawn into the helmet bymeans of an external lever.

To Follow

The findings of this study will enablethe researchers to make recommendations concerning:

- Which, if any, of the existing protectivehoods can be worn safely and effectively by firefighters in a given situation.
- Any hood design and/or material changes, regardingawareness of external temperatures and reduction of heat stress, that willbenefit the wearer.

It is anticipated that the final report onthe study will be presented to members of the Joint Committee on AppliancesEquipment and Uniform at their next meeting in September 1995.

PROJECTUPDATES

Fire Research News 19

In this section

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1 A Studyof the Degree of Protection Afforded by Firefighters' Clothing

The request for research in this area camefrom the Joint Committee on Appliances, Equipment and Uniform. The objectiveswere to:

1. investigate both the protection affordedand the thermal load imposed on a firefighter when wearing the A26 tunicand matching overtrousers in hot environments - ie current clothing;
2. study the practicality of adopting otherforms of outer garment, including one piece suits, giving the same or improvedlevels of protection; and
3. evaluate the available protective clothingsystems based upon the `layered' approach.

The research is being undertaken in collaborationwith the Institute of Occupational Medicine, Edinburgh. The questionnairephase of the work, involving all brigades in England, Scotland and Wales;the physiological phase undertaken at the Lancashire Fire Brigade InternationalTraining Centre at Chorley; and laboratory tests on all the garment fabricsto ensure that their physical properties conform to the relevant BritishStandard have been completed. The analysis of the data and preparationof the final report is now under way.

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2 Development of PracticalAptitude Tests for Fire Service Recruits

This work was requested by the Joint WorkingParty on Appointments Provisions to the Fire Service and is being carriedout in collaboration with the Ergonomics Research Unit of the Robens Institute,University of Surrey. The aim is to develop a battery of practical aptitudetests for fire service recruits on the lines of those currently used bysome brigades; and developed themselves. Our remit is to ensure that thetests are as valid and fair as possible to all potential recruits irrespectiveof gender, race and previous experience and, as far as possible, to distinguishbetween those skills/aptitudes in which an initial deficiency should becapable of correction through training and other essential skills unlikelyto be amenable to training.

Phase 1 of the work involving the developmentof the proposed tests based on data obtained from the physiological monitoringetc of recruits undergoing initial training has been completed.

The proposed tests were based on those aspectsof training identified during the study as being dependent on practicalaptitude. These were: ladder drills; breathing apparatus exercises; hoserunning drills; knot tying; and pick-up and carry body exercises.

The proposed tests are as job related as possible,in order to enable the candidates to understand the nature of a firefighters'job sufficiently to make an informed judgment as to whether they wish tocontinue with their application.

In-service validation of the proposed testsby fire service personnel at five brigades, under the supervision of theresearchers from the Robens Institute, commenced in mid-1993, after theproposed tests had been discussed with the Equal Opportunities Commission.The aim of this final phase of the work, which is nearing completion, isto allow fine tuning' of the tests to be undertaken before they are introducednationwide.

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3 Development of PsychometricTests for Fire Service Recruits

This work, undertaken in collaboration withPearn Kandola Downs, Occupational Psychologists, was aimed at developinga battery of psychometric tests (pencil and paper tests) specifically forthe fire service. This is required as a replacement for the Ability RangeTests (ART) which, it has been claimed, discriminate to some degree againstwomen and ethnic minority groups.

During the development of the proposed tests,which included a full analysis of a firefighters' job, particular attentionwas paid to the requirements of current race relations and equal opportunitieslegislation concerning indirect discrimination against female applicantsand applicants from ethnic minority groups.

The final phase of the work, namely the validationof the proposed tests, has been completed. This showed that:

1. the proposed tests are suitable for fireservice recruits;
2. there is no male/female bias; and
3. there is no apparent bias against ethnicminority groups.

The project was subsequently extended to includethe development of numeracy tests to be administered, at the end of thenormal selection process, by those brigades with a local need. These teststogether with the proposed psychometric tests were approved by the CentralFire Brigades Advisory Council Joint Training Committee in September 1994.Plans are now under way to introduce the tests to the fire service.

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4 Minimum and Maximum HeightRequirement for Fire Service Recruits

This research was requested by the CentralFire Brigades Advisory Council (CFBAC) Equal Opportunities

Joint Committeeas part of the development of equal opportunities policies within the fireservice. The aim was to establish:

1. whether an operational need exists forheight limits in the fire service;
2. whether physical requirements for thefire service currently tested by height may better be tested by some othermeasurement(s); and
3. what alternative measurements and criteriashould be introduced.

Work on this project, being undertaken incollaboration with the Robens Institute, University of Surrey, commencedin January 1993.

Thirteen brigades participated in the initialfact finding exercise undertaken to identify critical tasks/equipment.This included structured interviews with training staff and personnel withexperience of commanding (a) wholetime operational firefighters and (b)retained firefighters.

Suitable rigs were developed and the requiredanthropometric measurements etc taken both at fire stations and trainingcentres, and by means of a simulation study carried out in the laboratory.

All practical work on the project, extendedby two months or so to enable an assessment of the recently developed devicesfor removing ladders from appliances to be included in the study, has nowbeen completed. The final draft report has been prepared and a presentationof the work was given to the CFBAC Equal Opportunities Joint Committeein September, 1994 and to the Joint Working Party on Medical and PhysicalStandards in December 1994. The recommendations are currently under considerationby these committees.

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5 Health of ControlRoom Staff

This study is being carried out in collaborationwith the Robens Institute, University of Surrey, in order to:

1. investigate the environmental and ergonomicfactors within the control room likely to induce or exacerbate stress/stressrelated illness amongst control room staff;
2. investigate the incidence of stress andstress related illness amongst control room staff and identify whetherthe causes are environmental, organisational or non-work related;
3. assess the organisational/management structurewithin control rooms in relation to its possible role as a stressor.

Work started in October, 1993 and it is expectedto take two years to complete. The design of a questionnaire, to be completedby all control room staff in England, Scotland and Wales has been completedand was distributed to all control room staff at the end of June, 1994.

The second phase of the project which involvesthe physiological monitoring and interviewing of staff at twenty controlrooms together with the environmental monitoring/ergonomic assessment oftheir workplace commenced in July, 1994 and is nearing completion. Thecollation and analysis of the data received to date is now well under way.

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6 FirefighterMortality Study: A Second Follow-up

The findings of a previous study revealedthat firefighters have a much lower risk of death than the general population,from all causes of disease combined and from lung disease and lung cancerin particular. It was also demonstrated that firefighters do not have anincreased risk of developing ischaemic heart disease.

This second follow-up is being undertaken,in collaboration with the University of Manchester, for two reasons:

1. to confirm the original findings and
2. to determine whether the incidence ofcancer amongst firefighters is different to that expected for the generalpopulation.

The latter investigation is now possible dueto the establishment of a National Cancer Registry since completing theearlier work. This enables those participants in the study who have contractedcancer to be identified as soon as possible after first diagnosis - iewhile they are alive.

Work started in January, 1994. All the requiredinformation has been received from the participating brigades, NationalCancer Registry, National Health Service Central Registry and the Officeof Population Censuses and Surveys. The analysis of the data is now wellunder way. It is expected that the final report of the work will be completedby mid-1995.

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7 The Physiological Effectsof Wearing Breathing Apparatus (BA)

This study, undertaken in collaboration withthe Institute of Occupational Medicine Ltd., Edinburgh, involved firstassessing the potential problems of task and protective equipment combinationsby consulting all brigades in England, Scotland and Wales by means of twoquestionnaires.

One was aimed at the senior officer in eachbrigade responsible for:

- the selection and purchase of BA,
- operational policy regarding the use ofBA, and
- BA training.

The other aimed at operational firefighterswith considerable experience in the use of BA and associated equipment.

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8ArtificialAids to Vision on the Fireground Including the Acceptability of the New Visual Surgical Techniques

This project, requested by the Joint WorkingParty on Appointments Provisions, is being undertaken in order to:

1. investigate recent developments in theproduction of Breathing Apparatus (BA) sets compatible with the use ofartificial aids to vision, make an assessment of the reliability and safetyof such sets, and identify any implications which they may have for thevisual acuity of those wearing them with either spectacles or contact lenses;
2. assess the safety and efficacy on thefireground of the more recently developed spectacles and contact lenseswhen these are worn both with and without BA;
3. assess the safety and reliability, forfirefighters on the fireground (both with and without BA), of the new surgical/lasertechniques for improving eyesight defects;
4. determine the visual requirements necessaryfor the task of firefighting with regard to (a) colour discrimination and(b) distant and near visual acuity; and
5. assess the merits of all appropriate testsfor quantifying the level of vision and colour vision in order to adviseon those suitable for use by the fire service.

Work on this project, which commenced in February1993, is being undertaken in collaboration with the Department of Optometryand Visual Science, City University. It is expected to take three yearsto complete.

Work on phases1,2,4 and 5 of the study isnearing completion.

An interim summary report covering the proposedvisual standards, colour vision requirements, contact lens wear, spectaclesfor use on the fireground, and spectacle inserts for use with breathingapparatus has been prepared and was presented at the meeting of the JointWorking Party on Medical and Physical Standards held in April 1995.

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9 FireCover Model Update

The Fire Cover GIS package has now been launched(as a beta test version) and so far eight brigades have taken up the software.

Regional demonstrations of the package willbe arranged shortly and then further user groups and training sessionsshould follow in quick succession.

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10 A Review ofFire Safety Planning

The Home Office have prepared a new guideto help fire brigades organise their fire safety activities. This willreplace the original `INBUCON' report that was published twenty years ago.A fire service circular has been issued to all fire brigades in Englandand Wales together with five copies of the new guide.

Consultants are also currently developinga LOTUS 123 spreadsheet package which will supplement the guide and enablebrigades to forecast their manpower requirements for any given fire safetyworkload. Field trials of the package are currently taking place in WestMidlands, Staffordshire and West Yorkshire fire brigades.

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11 FireModels Training for Fire Safety Officers (FSOs)

There is a growing trend for building designersto use computer fire models to forecast the growth of an imaginary firewithin a proposed building design. These models may also be used to predictwhether the building occupants will be safe in the event of a fire. Theresults from these fire models may then be submitted with the buildingproposal to the local authority for approval. The Building Control Officermay in turn seek advice from the Fire Safety Officer on the adequacy ofthe fire safety measures.

To help FSOs gain a better understanding offire modelling studies carried out by building designers, FRDG are producingtraining manuals, each containing a set of exercises in fire modelling.This will allow FSOs to become familiar with fire models through hands-on'experience. Two training manuals will be produced, one for the Americanmodel HAZARD-I and one for the Danish model ARGOS. They are expected tobe completed by early 1996.

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12 Sprinklersand the Building Regulations

Fire protection measures in a building includeactive and passive measures. Active measures include fire detection systems,sprinkler systems and smoke control systems all of which take some actionwhen a fire

occurs. Passive measures include compartmentation of the buildingby barriers, which resist fire spread, and the provision of means of escape.The Building Regulations allow the relaxation of passive measures, forinstance by extending the travel distance for escape, when sprinklers areinstalled, but do not specify what is acceptable. There is concern thatbuilding designs may be approved where the relaxation in passive measuresmay lead to an insufficient level of fire safety.

The objective of this project is to providebetter guidance to brigades on what relaxations in passive measures areacceptable when sprinklers are installed in different types of buildings.The building types to be considered will be medium to large shops and largeoffice buildings. The research carried out will include sprinklered firetests and computer modelling. Results are expected by mid-1996.

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13 Siting of DomesticSmoke Alarms

The current Home Office advice on the sitingof domestic smoke alarms in two-storey houses is to install one alarm oneach floor. If only one alarm is installed in the house, the advice isthat it should be located on the ceiling at the bottom of the stairs whereit will provide early detection of fires which start downstairs. However,it can be argued that where only one alarm is installed it would be betterto locate it at the top of the stairs where it can also detect fires whichstart upstairs and where it is more likely to be heard from an upstairsbedroom.

The objective of this project is to determinethe best siting of a smoke alarm in a two-storey house if only one smokealarm is installed. Work began in November 1994 with a review of otherresearch in this area and a theoretical assessment of the problem. Thenext stage will be to carry out practical tests on smoke alarms and theirpositioning to determine their ability to detect fire and also their abilityto alert occupants of the house, whether they are awake or asleep.

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14 A CD-ROMon fire information

A CD-ROMof fire-related publications has been released by SilverPlatter InformationLtd in collaboration with HMSO. This computer-readable compact disc containsthe full text of a large number of publications including the following:-

- Fire related legislation
- Dear Chief Officer letters
- Fire Service Circulars
- Guides and Codes of Practice
- Research reports
- Manual of Firemanship
- Rules and syllabi issued by Fire ExaminationBoard
- NVQ for Fire Service standards of competence
- British and International Standards

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The disc will provide quick and easy accessto an increasing amount of data both for users within government departmentsand members of the public sector. The information will also be of benefitto other countries, particularly in the developing world, which do nothave such extensive information of their own.

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