
**Scottish Office and
Home Office**

**Risk Assessment and
Provision of Fire Cover
in Remote Rural Areas
of Scotland**

The work described herein was carried out under contract to, but it is not necessarily endorsed by, the Home Departments.

Entec UK Limited

REPORT RELEASE SHEET

**RISK ASSESSMENT AND PROVISION OF FIRE COVER IN REMOTE
RURAL AREAS OF SCOTLAND**

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Executive summary

This work has been prompted by the need to ensure that the new fire cover risk assessment method developed under the Joint Committee on the Audit Commission Report (JCACR), as described in the 1998 JCACR report "Out of the Line of Fire", can be applied to remote rural areas as well as urban areas. As part of this work the method was applied to a small part of sparsely populated areas in the Lothian and Border area. It was found that the risk to life from dwelling fires may not warrant retained fire cover, and recommended further work to explore whether an alternative form of fire cover could be warranted. The study reported here aims to test the application of the fire cover risk assessment method to a larger sparsely populated area, and identify alternative forms of fire cover that may match the risk in these types of areas.

Coincidentally, there is concern that the volunteer fire units which serve in many sparsely populated areas do not comply with current health and safety regulations, such as COSHH, and cannot be allowed to continue in service in their current form. To date two reports have been published offering views on the way forward.

1. the 1996 Highlands and Islands Standards of Fire Cover Review suggested upgrading a selection of 21 volunteer units to retained status, and subsequently disbanding nearby (those within 20 minutes attendance time) volunteer units - leaving 53 volunteer units. These proposals were based on the need to meet the current 20 minute recommended response time for D risk areas
2. the CACFOA "Volunteers: a case for change" report suggested upgrading volunteer units in all areas to auxiliary fire-fighters (auxiliary service), with CABA, midi-fire appliances, pagers and radios, a (basic) fire station and payment of retaining fees.

In addition, since the issue of these reports there have been three developments, namely:

1. The Community Fire Safety Task Force recommended a shift from response to prevention as the main means of reducing fire losses in the home.
2. The DETR report "Working together" regarding sharing of local service resources.

This study aims to first define a set of generally applicable guidelines on the levels of fire cover and community fire safety which can be warranted for sparsely populated areas to ensure that an adequate level of community safety is achieved and maintained. This is achieved by first assessing the risk to life and limb, using the methods developed on behalf of the JCACR, from fire and other types of emergency incidents in a sample of areas. Then, consideration is given to how these risks may most cost-effectively be reduced through fire cover and fire safety methods. Three fire cover options have been considered in detail; standard retained units, the Case for Change option and a Partly Retained Volunteer option based on current practice in some volunteer units who are supplied with a Light Fire Appliance, CABA, pagers and with 2 officers per unit paid retainers. The general guidelines and risk assessment methods are then applied to the Highlands and Islands and a small part of the Strathclyde region. The possibility of reducing service costs through partnering with other services has also been considered in these areas.

The method

1. The predominant risks to life in sparsely populated areas are from fire in the home and Road Traffic Accidents (RTAs) - indicating that fire cover can be based on these risks. The RTAs occur mainly in relatively larger communities, indicating that the assessment can be approached incrementally, first considering fire cover warranted for dwellings and then considering whether any additional fire cover is warranted for RTAs.
2. We have been able to establish a method for determining fire cover in remote rural areas based on risk assessment which fits in with the work completed for the JCACR. The significance of local fire and non-fire risks can be assessed against the guidelines applied here, with the type of fire cover matched to the type and level of risks identified. This method has been successfully applied to a sample of areas currently served by volunteer fire units.
3. Due to the relatively small numbers of people involved, the assessment needs to look at groups of remote rural communities as a whole and base the estimate of risk on the rate of dwelling fires.

It should be noted that the method applied here relies on the application of a statistical model of the relationship between response times and fatality rates. This model may be the subject of further research which could produce more precise statistical models. In addition, this work is based on the application of proposed risk criteria and cost-effectiveness guidelines, which are the subject of further review. Clearly, in the event that these guidelines are revised, the results for the areas studied here could change. Thus, it should be recognised that this study provides a demonstration of the method. Notwithstanding this, the statistical model, criteria and guidelines are “the best available” at this moment.

Tolerability of risk in sparsely populated areas.

Over the period 1992-96 the rate of fire death in dwellings is about 1 in 38,000 residents in those parts of Highlands and Islands served by volunteer units, compared to 1 in 49,000 residents for the Highlands and Islands as a whole. This is one of the highest rates of fire death for any region of the UK and would need to be more than halved to fall to the UK average.

The rate of fire death in sparsely populated areas needs to be reduced by at least 60% for it to fall to the UK average. This is equivalent to reducing the number of fire deaths from an average of 1.75 per year to less than 1 per year in the Highlands and Islands volunteer areas.

What impact might a concerted community fire safety education initiative have on fire deaths?

A detailed review of the circumstances of fire deaths in sparsely populated areas indicates that the vast majority could be prevented by improved fire safety, detection and resident response to fires, whilst only a minority might have been averted by a faster or better equipped emergency response.

The experience of other UK fire brigades, particularly, West Midlands and Lothian and Borders, indicates that the number of fire deaths can be significantly reduced by a well targeted and concerted

community fire safety initiative. Review of current community fire safety provision in sparsely populated suggests that there is significant scope for improvement. In particular,

- community fire safety work in the Highlands and Islands is concentrated in Inverness, where whole time staff are available, with only occasional school quizzes and ad hoc actions elsewhere,
- Strathclyde fire brigade has a large number of initiatives. However, these are focused on urban areas and are often implemented in association with organisations who either do not operate in rural areas or have a lower presence in rural areas, excepting the schools based programme.

Thus, there does appear to be great scope for developing and implementing community fire safety initiatives tailored to the particular needs of rural communities. Discussions with Strathclyde and Highlands and Islands fire brigades indicates that, with appropriate training and management, volunteers could make an important contribution to rural community fire safety work. Indeed, the involvement of local volunteers would be advantageous as they would provide a local resource, accepted as part of the community, for geographically isolated rural communities.

The actual cost of an initiative tailored to the needs and circumstances of rural communities has yet to be estimated. However, experience in other UK and US fire brigades suggests that an effective community initiative can be achieved at a fraction of the cost of fire cover, suggesting that the improvement of community fire safety in rural areas should be the most effective way of reducing fire deaths in sparsely populated areas and can be achieved at a lower cost than other options.

Balancing possible upgrades to community fire and RTA risk

Notwithstanding the importance of community fire safety, fire cover currently plays an important role in protecting life from fire and, in some areas, rescuing persons from RTAs and other non-fire emergencies. Therefore, there remains a need to match levels of fire cover to risk levels in these areas. The risk to life in sparsely populated areas is influenced by two main factors, namely the size of communities and the number of RTAs. The size of communities served by volunteer units varies greatly from under 100 to over 3,500 residents. The number of RTAs involving extrication of casualties coincides broadly with the size of communities, with more RTAs in larger communities. In addition, as a rule, hotels and other larger premises tend to be found in the larger communities.

In order to balance fire cover against risk to life, it is necessary have a means of deciding what level of expenditure society is generally willing to incur to protect against a certain level of risk. In this case we have followed the approach applied to other areas of public safety, such as road safety, where a cost of £850,000 is currently considered reasonable per life saved. Application of this guideline suggests that:

- the provision of standard retained fire units is warranted in communities of over 2,800 which are experiencing a medium rate of fire (as in the Highlands and Islands),
- the provision of units which match the standard laid out in the Case for Change is warranted in communities of over 1,680 which experience a medium fire rate (as in the Highlands and Islands),

- the provision of Partly Retained Volunteer units (equipped Light Fire Appliances, CABA, pagers and garages) is warranted in communities of over 980 which are experiencing a medium rate of fire (as in the Highlands and Islands).

The location of RTAs, other life threatening special services and other types of premises such as hotels has also been examined. In the main they coincide with the relatively more populated areas. However, in a few cases they occur in medium sized communities (980 to 1,680 persons), thereby adding weight to the case for one or another of the new types of units in these areas.

The application of these guidelines would suggest that about 21-37 volunteer units are warranted in the sparsely populated parts of Highlands and Islands. The exact number depends on the extent to which neighbouring volunteer/retained units would be able to serve neighbouring communities within the recommended response time of about 15 minutes. In the case of Highlands and Islands this would provide retained or partly retained cover to 75% of the population in sparsely populated areas.

The impact of using different guidelines on the cost per averted death are examined in the main report.

Attention should be awarded alternative means of providing fire cover in the smaller communities. In particular, our findings suggest that consideration can usefully be awarded:

- partnering opportunities with the Scottish Ambulance Service (SAS) and the Coast Guard. This includes the possibility of sharing premises and, in the case of SAS sharing personnel.
- developing non-mobile volunteer units, with (say) 6 members equipped with CABA, and all 10 with pagers and portable pumps etc.

In addition, it is pertinent to note that in the case of smaller communities (under 1000 residents), the cost of installing domestic sprinklers in all dwellings should be less than the cost of fire cover.

Conclusions

It is possible to apply the risk assessment methods developed on behalf of the JCACR to remote rural areas. In the case of the Highlands and Islands, the application of the method suggests that:

- The implementation of community fire safety initiatives, tailored to the needs and circumstances of rural communities, is the most effective way of reducing fire deaths in these areas.
- Provision of one or another type of retained fire unit is commensurate with the risk posed by RTAs and fires in the home in the (relatively) larger rural communities.
- Alternative means of providing fire cover should be sought for the smaller communities, including partnering with other emergency services and non-mobile CABA units.

- PICTURES - see separate file

A volunteer unit “garage” with Light Fire Appliance (adapted transit van), toilet and space for CABA/pager - as proposed by this study for medium sized communities.

The Beauvy volunteer unit with Ultra Light Fire Appliance (Ford Escort van) - serving over 3,500 residents. Study suggests this could be replaced by a retained unit.

- PICTURES - see separate file

Applecross - a small remote community of about 220 residents on the western coast of Scotland - best served by an upgraded non-mobile CABA unit or domestic sprinklers.

The current non-mobile volunteer fire unit at Applecross.

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1. INTRODUCTION

1.1 Background

This work has been prompted by the need to ensure that the new fire cover risk assessment method developed under the Joint Committee on the Audit Commission Report (JCACR), as described in the 1998 JCACR report "Out of the Line of Fire", can be applied to remote rural areas as well as urban areas. This work focused on urban and relatively highly populated areas, such as towns, for which some form of retained or whole time fire cover is usually appropriate. As part of this work the method was applied to a small part of sparsely populated areas in the Lothian and Border area. It was found that the risk to life from dwelling fires may not warrant retained fire cover, and recommended further work to explore whether an alternative form of fire cover could be warranted. The study reported here aims to test the application of the fire cover risk assessment method to a larger sparsely populated area, and identify alternative forms of fire cover that may match the risk in these types of areas.

Coincidentally, there is concern that the volunteer fire units which serve in many sparsely populated areas, of which there were 146 in total in 1997 involving approximately 1,400 personnel, do not comply with current health and safety regulations, such as COSHH, and cannot be allowed to continue in service in their current form. As 98 of these units reside in the Highlands and Islands area and 31 in the Strathclyde region attention has focused on these units.

To date two reports have been published offering views on the way forward for volunteer units, as noted below. However, these reports have been developed in the context of the current Fire Cover standards which the ongoing risk assessment work is intended to replace.

1. Firstly, the 1996 Highlands and Islands Standards of Fire Cover Review suggested upgrading a selection of 21 volunteer units to retained status (and upgrade of one retained to whole time), and subsequently disbanding nearby (those within 20 minutes attendance time) volunteer units. Also, some volunteer units are within 20 minutes of existing retained stations and so could also be disbanded - 8 units in total. The premise for these proposals was the need to meet current recommended response time standards for D risk areas, namely 1 appliance in 20 minutes. Therefore, of 98 volunteer units this would lead to disbandment of 24 units and 21 upgraded to retained status - leaving 53 volunteer units. To date 3 units have been upgraded to retained status.
2. Subsequently, the CACFOA "Volunteers: a case for change" report suggested upgrading volunteer units in all areas (except those where units could be disbanded) to a new category of "auxiliary units" (auxiliary service). This work was driven mostly by concerns about fire-fighter safety. The standard allows for equipping and training personnel in CABA, provision of a midi-fire appliance, pagers and radios, and construction of a (basic) fire station and payment of retaining fees. It was proposed to prioritise upgrades according to the travel time to the nearest retained unit, with more remote units awarded priority.

In addition, since issue of these reports there have been two further developments, namely:

1. The Community Fire Safety Task Force issued a report titled "Safe as houses" which recommended a shift from response to prevention as the main means of reducing fire losses in the home.

The Home Office has declared a goal of reducing fire deaths by 40% over the next five years, primarily through higher levels of fire safety education, and are considering making fire safety education a statutory duty. Whilst the Home Office responsibility is limited to England and Wales, the emphasis placed on community fire safety is also under consideration in Scotland.

2. The DETR issued "Working together" which suggested that local services should seek out means of sharing resources to reduce costs. The same possibility of partnering and working together has been raised for Scotland in the context of the Comprehensive Spending Review.

Therefore, it is opportune to develop and test the risk assessment method in the context of the sparsely populated parts of Scotland.

This study aims to first define a set of generally applicable guidelines on the levels of fire cover and community fire safety which can be warranted for sparsely populated areas to ensure that an adequate level of community safety is achieved and maintained. This is achieved by assessing the risk to life and limb, using the methods developed on behalf of the JCACR, from fire and other types of emergency incidents in a sample of areas and thence considering how these risks may most cost-effectively be reduced through fire cover and fire safety methods, using the option identified in the Case for Change report where appropriate. The general guidelines and risk assessment methods are then applied to the Highlands and Islands and a small part of the Strathclyde region. The possibility of reducing service costs through partnering with other services has also been considered in these areas.

One part of the risk assessment entails application of a statistical model of the relationship between fire brigade response time and the risk of death from fire in the home. The current version of this model is based on an analysis of over 12,000 dwelling fires drawn from across the UK. An initial validation test, completed as part of the JCACR research, found that the predicted rates of death were within a factor of two of the reported rates in a sample of rural and metropolitan fire brigades - suggesting that reasonable confidence can be placed in its application across the UK. However, it should be noted that further research into the relationship between response times and fatality rates has been recommended. This further research would aim to ascertain whether a more powerful model can be developed by considering other intervening variables which might be peculiar to certain areas and that may alter the relationship between response times and fatality rates. Such research may or may not recommend alternative statistical models for different types of areas and/or types of fire units.

The fatality rates reported for the sample of sparsely populated considered in this study are compared to the predictions of the national statistical model, as a very provisional and partial validation exercise. However, with only 1.75 fire deaths in the study area each year, the sample of data is insufficient to provide definitive conclusions on the validity of the national model for sparsely populated areas.

In the meantime, this study demonstrates the application of the risk assessment method, including the statistical model, to sparsely populated areas. The conclusions can be said to be based on the current best available evidence regarding the effect of fire cover on risk.

Attention is focused on fire risk in the home and Road Traffic Accidents (RTAs) as these account for the vast majority of casualties in sparsely populated areas. As the proposed upgraded volunteer units are not designed to control large conflagrations, less attention has been awarded to the risk posed by larger premises, such as factories, especially as there are few such premises in the areas surveyed in this study.

1.2 Approach to the study

The study has two main parts, namely:

1. Development of a set of general guidelines, using the methods applied during the JCACR study, for scoping fire cover and fire safety in sparsely populated areas. The aim here is to develop a set of guidelines that can be used to identify the level of fire cover that is warranted for the purpose of saving life in any sparsely populated area. These general guidelines may be used to review whether the existing standard of fire cover is appropriate or whether, in cases where there is no local fire cover, fire cover should be provided.
2. Application of these guidelines to the Highlands and Islands and Mull in the Strathclyde region. The aim here is two fold, firstly to demonstrate how the approach can be applied to sparsely populated areas and secondly to use the study as an opportunity to suggest what level of fire cover is appropriate in areas currently served by volunteer units.

The second part of the study has considered all of the areas served by volunteer units in the Highlands and Islands, including a review of dwelling fire risks and RTAs in all 10 districts and review of other risks, such as hotels, in 3 districts. The Isle of Mull has been taken as an example of an area covered by volunteer units in the Strathclyde region. These areas are taken as examples from which to generate generally applicable guidelines.

We have approached the second part of the study in an incremental fashion by first examining the level of protection warranted on the grounds of fire risk to life in the home and then considering whether the inclusion of other risks (RTAs and hotels) alters the outcome of the review, i.e. do RTAs and other risks coincide with those communities which warrant a given level of protection on the grounds of fire risk in the home. An initial review of these areas indicated that there are 2 main sources of injury, namely fires in the home and Road Traffic Accidents. The number of other types of premises - predominantly hotels, shops and schools - varies between communities, but is typically no more than 10 to 20 one or two storey buildings for an average of 35 persons.

Also, the following principles noted in the JCACR research have been applied when considering how to reduce fire risk in the home:

1. Community fire safety education and other methods of fire prevention and fire safety, such as advocating improved fire detection, should be awarded equal importance (as a minimum) to fire cover.
2. Where the current risk level is considered to be too high, fire authorities should consider all possible fire prevention and fire safety interventions in parallel to the option of increasing levels of fire cover.
3. The methods of risk reduction may include initiatives which are directly applied by the fire service and methods which are applied in conjunction with other agencies and organisations.
4. The cost of any increase in fire cover implemented in parallel with additional community fire safety programs should meet guidelines on cost-effectiveness.
5. The selected package of measures should achieve the greatest level of risk reduction for the least possible cost. Costs should, as a minimum, come within the limit of what society is willing to spend for each incremental reduction in risk.

Community fire safety is an integral part of fire cover

Partnering and working together

Finally, the risk posed by other premises, such as hotels, is considered, taking account of their level of occupation, number of such buildings and risk of persons being trapped by fire. As the proposed units have not been designed to manage large uncontrolled fires, with ladders reaching 2nd storey only, we have only considered the possibility of individual rescues from these premises. This is reinforced by the finding that the number of large premises is not significant in individual volunteer areas. Nonetheless, a check has been made on the coincidence of other premises with dwelling and RTA risk to determine whether volunteer units are already required to protect residents and RTA victims in those communities with relatively more hotels etc. Similarly, the types of fire appliance proposed within the Case for Change lacks off-road capability, thereby limiting the additional benefit it offers over and above existing units in the handling of moorland or forest fires.

1.3 Fire Cover Options

It is currently possible to identify three fire cover options which should allow safe rescue of dwelling occupants. These options, along with their total annual costs, are summarised below in Table 1.1. The options are:

1. **Standard Retained Fire Unit** - Provision of retained fire units.
2. The **Case for Change (CfC) option**: Provision of units which meet the standards outlined in “A Case for Change”.
3. **Partly retained volunteer unit option (PRV)**: Provision of units modelled on the standard achieved by some existing volunteers units, namely equipped with short wheel based Light Fire Appliances (LFAs - adapted transit vans), pagers and CABA, with a “garage” type fire bay but with payment of retainers to some officers and a higher standard of training.

These options are hereafter referred to as the Standard Retained, Case for Change (CfC) and Partly Retained volunteer unit (PRV) options.

A more detailed summary of these options and a breakdown of costs is given in Appendix A. Options 2 and 3 relate to a new standard of volunteer fire cover referred to as the “auxiliary” fire service within the Case for Change. In all cases the options relate to units which should be capable of safely conducting a rescue operation from a dwelling house, typically one or two storey houses in rural areas.

The actual costs of units will vary according to local factors, such as land prices and the number of turnouts etc. Also, the interest rate applied to loan charges may change from year to year. Therefore, the actual costs may vary by at least 10% from those indicated here. In addition, the conditions of service, particularly retainer fees and the number of volunteers to be equipped with CABA has yet to be finalised.

It is entirely possible that other types of fire cover could be developed. Some further possibilities specific to the Highlands and Islands and Isle of Mull have been identified. However, the operational practicality and cost of these options have yet to be confirmed. Therefore, they have not been the subject of detailed review in this study. Rather, they are identified in section 5 for further consideration in the event that an alternative to the three existing options is required.

The study has initially considered the benefit, in terms of lives saved, which these units may achieve compared to “no fire cover”. The possibility of relying on the existing standard of volunteer fire unit, which does not include Compressed Air Breathing Apparatus (CABA), ladders, training or fire appliances, is not considered to be viable in the context of safely undertaking rescues of persons from dwelling fires.

Table 1.1: Fire cover options

Option	Description	Approx. Annual cost
Standard Retained fire unit	Standard retained fire unit.	£100,000
Case for change	<p>As per the “Case for Change” document.</p> <p>10 fire fighters paid 80% of normal retainer, trained and equipped in CABA, pagers and full uniform. 12 turnouts per year.</p> <p>One Light Fire Appliance, with longer wheel base and greater gross and axle weight limit.</p> <p>Fire station with toilet, CABA room, compressor , drying room, PPE storage, lecture area etc. as per Case for Change.</p> <p>Assumes higher construction costs.</p>	<p>£60,000</p> <p>(based on Highlands and Islands costing)</p>
Partly retained volunteer unit	<p>As per examples of existing LFA/CABA/pager equipped units plus retaining fees and training</p> <p>2 fire fighters paid 80% of normal retainer, ie leader and deputy. 6 fire fighters trained and equipped in CABA, pagers and full uniform. Under 10 turnouts per year</p> <p>One Light Fire Appliance with shorter wheel base and lower weight limit - as per adapted transit van.</p> <p>A single appliance bay with CABA storage room, toilet and space in bay for pager and uniforms only - assuming lower construction costs.</p>	<p>£35,000</p> <p>(based on project discussions and brigade data)</p>

2. PART 1: GENERAL FIRE COVER GUIDELINES

2.1 Aims

The aim of this section of the report is to develop a set of guidelines for sparsely populated areas which fire brigades can use to identify an appropriate level of fire cover for a specific area, such as a single community or collection of communities, and any other areas where the cost-effectiveness of even a retained fire unit is in doubt. Two sets of fire cover guidelines are discussed.

Firstly, guidelines are presented for the assessment of the tolerability of risk and for identifying the response times and level of fire safety required to ensure tolerable risk levels are achieved.

Secondly, guidelines are presented showing the level of fire cover that is cost-effective on the grounds of reducing risk to life from fire in the home. These cost-effectiveness guidelines are presented in two formats, namely:

1. the minimum number of residents (in an area experiencing a certain rate of dwelling fires and/or casualties) required to warrant a given type of fire cover at a given cost, and;
2. the expenditure per head of population (in an area experiencing a certain rate of dwelling fires and/or casualties) that can be warranted to achieve a given response time capable of undertaking a rescue. This can also be presented in terms of the expenditure per *n* persons that can be warranted.

In both cases, the guidelines relate to a population who can be reached by a fire unit within a given time, such as 11 to 15 minutes. The population may be “clumped” within one or more villages or dispersed less densely across a rural area - so long as they may be reached within the specified time by an existing or hypothetical (proposed) fire unit.

The first cost-effectiveness guideline is provided for those situations where the cost of a particular type of fire cover has been estimated. It allows authorities to ascertain whether there is a sufficient number of residents in a particular area to warrant the expenditure required to provide the type of fire cover in question. However, in other cases, fire cover options and/or their costs may not have been specified, an authority may be unable to afford the initial option or the community may not be large enough to warrant the expenditure required for the initial option. In these cases, the second guideline is provided to give an indication of the level of expenditure that can be warranted. Authorities can subsequently use this expenditure level as a guide during the development of new fire cover options.

In the first case we have held the cost of each fire cover option constant (at £35,000, £60,000 and £100,000 per unit as per Table 1.1) and determined the number of residents required for the cost per life saved to match levels classed as cost-effective - to identify which communities warrant one or another of the 3 types of fire cover.

In order to apply the guidelines fire brigades need only identify the number of residents in an area and the rate of fire and/or fire casualty. In all cases it is assumed that the fire cover is capable of safely undertaking a rescue of dwelling occupants.

Guidelines are also presented regarding the level of cover that may be warranted for extricating casualties from Road Traffic Accidents and other non-fire incidents, such as persons trapped in machinery. These guidelines are presented in the form of the minimum number of incidents required to warrant a given level of fire cover.

In all cases the guidelines indicate the maximum level of expenditure that can be warranted for the risk. This should not be interpreted to indicate the cost or type of fire cover that must be provided. The same level of fire cover could conceivably be achieved at lower cost.

2.2 Achieving tolerable levels of risk

2.2.1 Estimating rates of dwelling fire and fire casualty

The first stage of risk assessment asks, in the context of fire risk in the home, “What is the rate of dwelling fire in the area?”. The rate of fire and/or rate of fire casualty in the area is used as an indication of the risk presented by fire. In order to simplify the process of review, “bands” of rates of fire are classified as Low to Very High as shown in Table 2.1. This also allows for a modicum of statistical uncertainty and reporting variation in reported rates of fire.

The area may be categorised using one or both of the reported rate of dwelling fire and the reported rate of fire casualty, which ever is considered to provide the most accurate and reliable measure of risk. However, a statistically reliable sample of fires is required. As a rule, a minimum of four years data is required for a population of about 50,000 persons. Reliance should not be placed on the rates reported in any one village (of say 1000 persons), where the absence of fire in any one year or even a period of (say) 4 years is of little statistical significance. Rather, in the case of a group of small communities, it is necessary to look at them as a whole to gain a reliable measure of the rate of fire and/or fire casualty.

In the case of smaller communities, even when a group of villages are considered as a whole, it may still be necessary to apply an element of judgement when deciding whether to rely on the reported rate of fire or fire and casualty - especially if the two measures do not concur. Typically, preference should be awarded to the rate of fire per dwelling due to the larger number of fires than fire casualties. This is particularly true in the case of smaller or less densely populated areas where there are few, perhaps less than 10, fire casualties per year.

Table 2.1: Categorisation of rates of fire

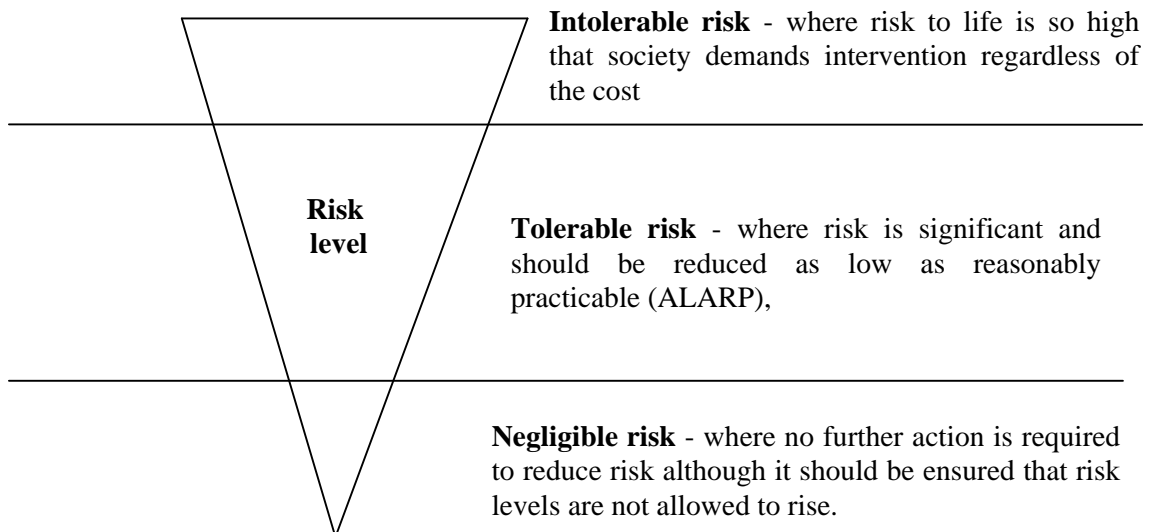
Fire Rate Category	Quantitative criteria.		
	Annual rate of dwelling fire casualty per person	Annual rate of fire per dwelling	Annual rate of dwelling fire per person
Very high rate	Over 1 in 1,000.	Over 1 in 200	Over 1 in 450
High rate	1 in 1,000 to 1 in 2,000	1 in 200 to 1 in 400	1 in 450 to 1 in 900
Medium rate	1 in 2,000 to 1 in 5,000	1 in 400 to 1 in 800	1 in 900 to 1 in 1800
Low rate	Under 1 in 5,000	Under 1 in 800	Under 1 in 1800

2.2.2 Defining minimum response standards

Having derived an estimate of the rate of fire/fire casualty in an area, the next step is to determine the minimum level of fire cover and community fire safety work required to achieve a tolerable level of risk. This is achieved by the application of a statistical model of the influence of fire brigade response times and community fire safety work on fatality rates and a set of risk criteria relating to the tolerability of risk. The statistical model, as elaborated below, provides a quantitative measure of the reduction in risk of death per fire for various response times. This is used in conjunction with the estimated rate of fire (or fire casualty) in a particular area to indicate the approximate annual rate of death for a given response time standard. The risk criteria are used as a guide to the tolerability of risk, and hence the level of fire cover (or response time) required to achieve a tolerable level of risk in an area with a particular rate of fire.

Risk criteria

The level of fire cover (or response time) that is required depends on the tolerability of risk. The reaction to different levels of fire risk in the home can be distinguished, as per HSE guidance on the tolerability of risk, as follows:



In practice, the JCACR research suggests that these criteria can be interpreted as follows:

- the upper risk level is a national guideline that must be met, wherever effective means exist to reduce the risk further regardless of their cost, i.e. it is the minimum that all fire authorities should seek to achieve on behalf of the local community.
- the ALARP criterion means that risks in this region must be reduced wherever this can be done cost-effectively. This means that cost is a legitimate consideration in this situation, as well as the judged effect of alternative interventions on the loss of life.
- where risk is in the negligible region, this means that, as a rule, society at large would not demand that further steps be taken to reduce the risk further and so there is no expectation that fire authorities will pursue further measures- however, it is open to local authorities to attain yet higher standards of safety if there are special considerations in this locality.

To apply this framework it is necessary to have some criteria by which to judge the tolerability of risk. Some initial proposals for risk criteria were given as part of the JCACR research, as shown in Exhibit 2.1. However, these criteria do not as yet have any formal status. Therefore, benchmarks are also presented for comparative purposes in this study.

**Exhibit 2.1:
Quantitative criteria for assessing tolerability of risk to life from fire in the home**

Risk Criteria noted in JCACR research

- an annual risk of death from fire in the home greater than 1 in 50,000 per person should be regarded as intolerable,
- an annual risk of death from fire in the home less than 1 in 1,000,000 per person should be regarded as negligible, and;
- risks in between these levels are tolerable but should be reduced wherever cost-effective means can be identified. This is referred to as the ALARP region, where risk needs to be reduced “As Low As Reasonably Practicable”.

Taking the whole UK as an example, the risk of death from fire as indicated below, is currently within the “tolerable” region and should be subject to the ALARP principle.

1995 Benchmarks - dwellings

Annual rates of death

Average for UK	=	1 in 111,000 persons
Average for Scotland	=	1 in 68,480 persons

Annual rates of fire casualty (deaths and non-fatal)

UK	=	1 in 4,412 persons
Scotland	=	1 in 3,300 persons

Annual rates of dwelling fire per person

UK	=	1 in 901 persons
Scotland	=	1 in 574 persons

Finally, in considering the tolerability of the current level of risk, it may also be useful to calculate the fatality rate and compare this with the risk criteria - to supplement the risk categorisations derived from the rate of fire and fire casualty. Given the small numbers of fire deaths that are likely to occur in any one sparsely populated area or year, it is necessary to estimate fatality rates for a larger area and a number of years. As a rule, a 4 year period should be considered for a population of at least 50,000 persons to gain a reasonably reliable estimate of the fatality rate. Notwithstanding this, observation of a higher than average fatality rate would tend to suggest a need to review the level, type and location of fire cover and fire safety work in an area. However, it should be noted that observation of a low fatality rate may not indicate a low risk area, as the low fatality rate may be due to the life saving

intervention of local fire cover. Conversely, the national statistical model predicts a high fatality rate in low or medium risk areas which have a low level of fire cover. Thus, it is necessary to take account of the effect of existing fire cover when considering whether the reported fatality reflects a high or low risk of fire in a particular area.

The national model of response times and fatality rates

The national statistical model is shown in Figure 2.1. The rate of fire or fire casualty is plotted on the horizontal axis. This rate is multiplied by a fatality rate per fire for each response time, as shown by the parallel lines on the figure, to give a predicted annual rate of death measured on the vertical axis. In all cases, it is assumed that the response is capable of safely conducting a rescue from a dwelling fire. Persons in areas with higher rates of fires and/or fire casualty and slower response times tend to have a higher risk of fatal injury. The figure also indicates the upper risk criteria, beyond which risk is classed as intolerable.

Whilst the model was derived using the data on fire casualties, it is equally valid to apply the model using the rate of fire per dwelling, after modifying the statistics to allow for the number of residents per dwelling, given that there is a simple ratio of fires to fire casualties.

It should be noted that:

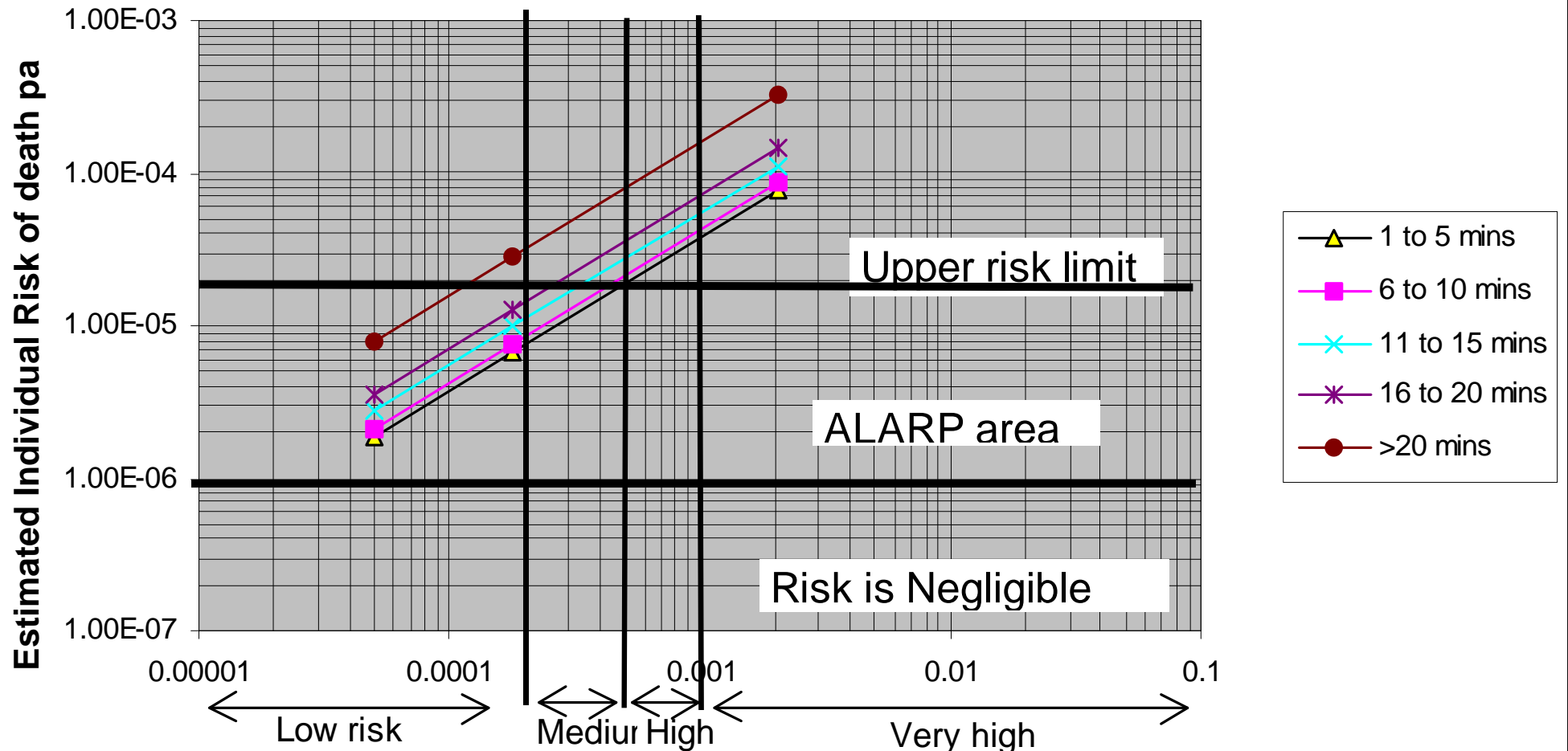
- fire cover alone is unlikely to reduce the loss of life and injury in areas assigned Very High and High Fire Rate categories to tolerable levels. Accordingly, a reduction in the rate of fire and casualty is required in these areas for risk to fall to tolerable levels.
- areas assigned Low and Medium Fire Rate categories areas also need community fire safety but with a lower priority, perhaps with targeting of “at risk” groups across all of these areas rather than targeting the whole community.

As regards fire cover, it can be noted that the following response times should keep risk to a point just within the limit of tolerability in Low and Medium risk areas:

Medium Fire Rate areas	-	11 to 15 minutes
Low Fire Rate areas	-	16 to 20 minutes

In the case of areas assigned High and Very High Fire Rate categories, a 6 to 10 minute response should reduce the risk as close to the upper limit as can effectively be achieved by fire cover alone. However, this should not be interpreted to imply that, in those cases where existing fire cover does not achieve this response time that a higher level of cover is immediately required. Rather, it is equally valid to seek to reduce the rate of fire and casualty in an area through a community fire safety programme and matching fire cover to the subsequent, lower level of risk. At the very least, the ALARP test of cost-effectiveness should be applied to fire cover in Very High and High risk areas where fire cover is increased prior to the outcome of a community fire safety initiative becoming apparent.

Figure 2.1: Individual Risk to life from fire in dwellings for various attendance times and rates of casualties



2.3 Assessing cost-effectiveness of fire cover options

2.3.1 Aims

The next step in the risk assessment is to identify a type or level of fire cover that can achieve the target response time cost-effectively. This is done by comparing the cost per life saved of alternative types of fire cover in areas with different population sizes and rates of fire. To help determine which option(s) can be classed as cost-effective, the cost per life saved is compared against the current guideline applied by various Government departments to expenditure related to public safety. The guideline suggests that interventions costing up to ~£850,00 per life saved are regarded to be cost-effective. However, whilst the value of £850,000 per life saved is commonly used by a number of Government departments, this is neither a fixed value nor a rule. Therefore, we have applied a higher and lower value of £425,00 and £1,250,00 to test the sensitivity of the analysis to changes in the assumed value of life.

As this is a research study, the form of calculation is shown below. However, the aim is to produce two inter-changeable sets of guidelines which fire brigades can apply simply by estimating the number of people in an area, without being obliged to calculate the cost per life saved for each and every fire cover review. The guidelines are presented in the form of:

1. an expenditure per head of population that can be warranted in areas with a certain rate of fire and certain response time,
2. the number of residents required to warrant a given cost of fire cover in an area with a certain rate of fire and certain response time.

As previously, mentioned the guidelines indicate the maximum level of expenditure that can be warranted rather than the cost that is required. In this way they comprise upper “limits” within which a fire authority should operate.

This calculation only covers rescue of persons from fires in their homes and excludes other life saving activities such as extrication of persons from cars, which are considered later on in this section.

2.3.2 Estimating reduction in risk of death per person

It is first necessary to estimate the number of lives saved by a particular intervention before the cost per life saved can be calculated. The estimation of the numbers of lives saved is derived from the statistical model, shown in Figure 2.1, of the relationship between response times and fatality rates in dwelling fires. The model indicates a fatality rate for different response times, with higher fatality rates for slower response times. For example, 1 in 24 fire casualties are likely to be fatally injured with a 6 to 10 minute response time, compared to 1 in 18 for a 11-15 minutes response time. The highest fatality rate is observed for response taking over 20 minutes, a 1 in 6 fatality rate per fire casualty. This is taken to equate to a “no fire cover” fatality rate as persons remaining in a serious fire after this time are very likely to be fatally injured. The reduction in fatality risk is given by the difference in the fatality rates of

alternative response times. For example, a 11-15 minute response time should reduce risk of fatal injury by about 65% compared to “no fire cover”, ie averting 6.5 out of every 10 deaths which would otherwise occur.

The reduction in risk in a particular area must take account of the local rate of fire and/or fire casualty - as people are more frequently involved in fires in some areas than others. Therefore, to estimate the number of lives saved by a given response time it is first necessary to assign a rate of fire casualty to an area then factor this rate of casualty by the appropriate response time,

$$\begin{aligned} &\text{Rate of casualty per head X rate of fatality for } \mathbf{chosen} \text{ mins response} \\ &= \text{local fatality rate per person} \end{aligned}$$

In algebraic form this is:

$$C_a \times F_r = F_a$$

Where:

- C_a is the annual casualty rate per person for the surveyed area a.
- F_r is the fatality rate per fire casualty for a certain response time r.
- F_a is the annual fatality rate per person in the surveyed area a.

This is illustrated below for a hypothetical high risk area and a 11-15 minute response time, remembering that this response time has a 0.055 fatality rate per fire casualty. This example is completed using a casualty rate of 1 in 1,500 (0.00066) per year per person.

$$0.00066 \times 0.055 = 0.000036 \text{ ie 1 in 28,000 per person per year}$$

This is compared with the fatality rate for a “no fire cover” situation of:

$$0.00066 \times 0.16 = 0.00011, \text{ ie 1 in 9,100 per person per year}$$

The reduction in risk of death per individual is given by the difference between these two values, ie:

$$0.00011 - 0.000036 = 0.000074 \text{ per person per year,}$$

This is equivalent to a reduction in risk of death per person of 1 in 40,000 per year, or one less death per 40,000 residents each year.

It should be noted that this calculation can also be completed using fatality rates per dwelling fire, using modified fatality rates for different response times to take account of the ratio of dwelling fires to casualties, as per:

$$D_a \times F_r = F_a$$

Where:

- D_a is the annual rate of fire per dwelling,
- F_r is the fatality rate per dwelling fire for a certain response time r .
- F_a is the annual fatality rate per person in the surveyed area a .

This is illustrated below for the medium rate of dwelling fire reported in Highlands and Islands. Referring back to the JCACR research, the rate of fatality (in medium risk areas) per dwelling fire is 1 in 15.6 (0.064) for responses of over 20 minutes, versus 1 in 45 (0.022) for a 11-15 minutes response time. The reduction in rate of death per fire is the difference between these two values multiplied by the rate of fire per dwelling per year (reported at 0.0022 per dwelling), ie:

$$(0.064 - 0.022) \times 0.0022 = 0.0000924.$$

To estimate the reduction in rate of death per person, it is necessary to divide this value by the typical number of residents per dwelling, which is about 2.2. Thus, with about 2.2 persons per dwelling the reduction in individual risk of death is:

$$0.0000924 \div 2.2 = 0.000042 \text{ per year per person.}$$

This equates to one less death per 24,000 residents each year.

2.3.3 Guidelines on expenditure per head of population

The expenditure per head of population that can be warranted to achieve the estimated reduction in risk per individual is calculated by multiplying the fractional reduction in annual risk of death by the current Government guideline on the value of a life, such as the value of £850,000. Thus, for the high risk case shown above, the expenditure per head is:

$$0.000074 \times £850,000 = \sim£63 \text{ per head}$$

Similarly, for the medium risk case above, the expenditure per head is:

$$0.000042 \times £850,000 = £36 \text{ per head per year}$$

This latter value can be used to assess the cost-effectiveness of fire cover options in areas with medium rates of fire.

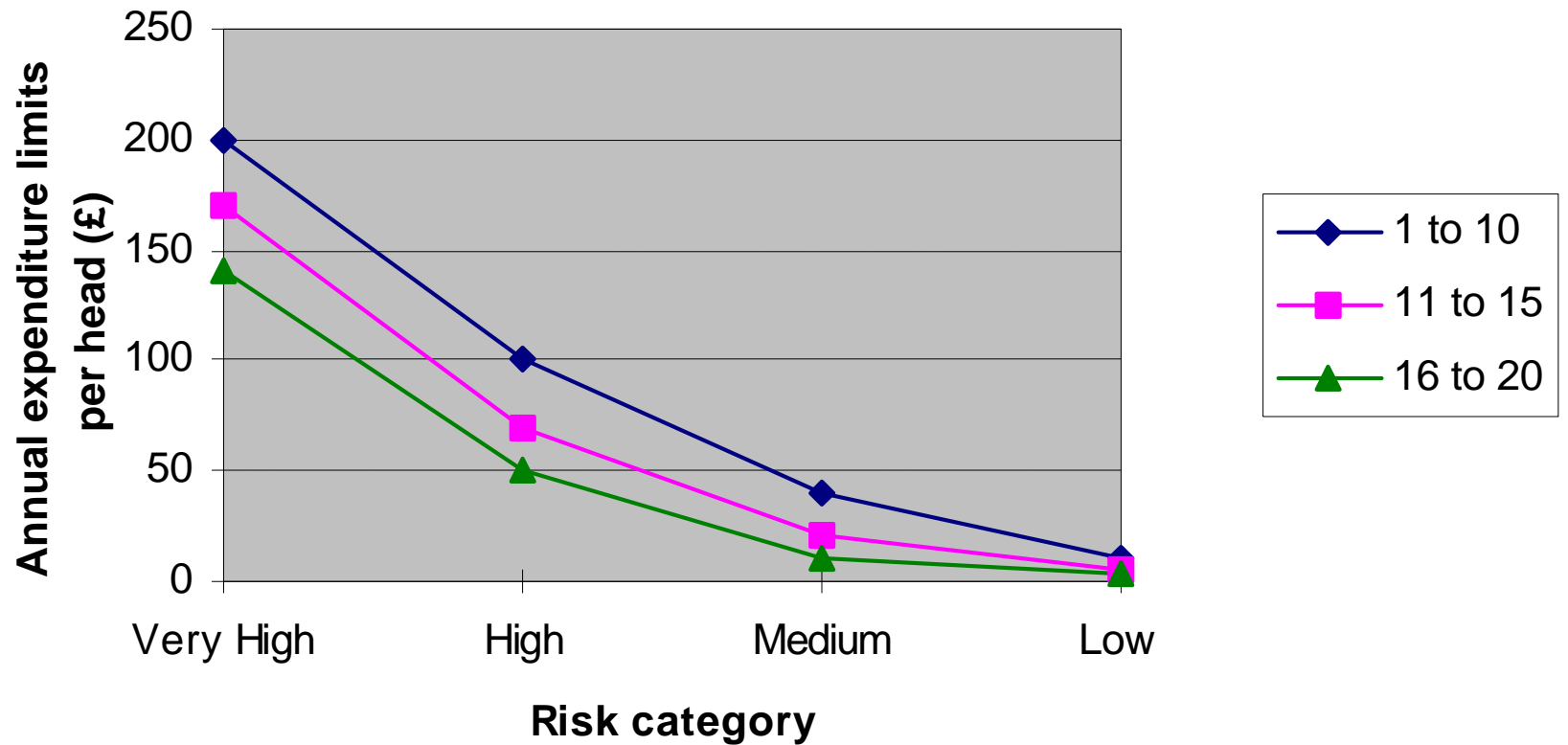
This calculation can be repeated for various rate of fire and response times to give a spread of per head expenditure limits, as shown in Table 2.2. These expenditures are based on the mid-point casualty rate within each Fire Rate Category. As the actual rate of fire varies within each

“Fire Rate Category”, a more precise calculation can be made by applying the actual casualty rate assigned to an area - which may give a higher or lower cost per head. Figure 2.2 shows how the annual expenditure limit per head increases gradually (for the same response time) as you move from (say) the mid-point of the medium risk category towards a high rate of fire. Thus, where the rate of fire is at the upper end of the medium risk “band”, the expenditure per head would be closer to ~£60 than £20.

Table 2.2: Fire Cover expenditure limits per head

Fire Rate Category	Annual expenditure (£) per head warranted for each response time (minutes) (1998 prices)			
	1-5 mins	6 to 10 mins	11 to 15 mins	16 to 20 mins
Very high	200 to 170		170 to 140	140 to 100
High	100 to 70		70 to 50	50 to 40
Medium	40 to 20		20 to 15	15 to 10
Low	10 to 5		5 to 3	

Figure 2.2: Annual expenditure limits per head of population



2.3.4 Guidelines on residents required for each type of cover

In those cases where the cost of a certain type of fire unit has been estimated, it is possible to estimate the number of residents required to warrant that expenditure by dividing the actual cost of fire units by the suggested expenditure limit per head of population. Thus, an estimated fire cover cost of (say) £60,000 would be divided by ~£50 to ~£60 where it serves a high risk community in a 11-15 minute response time, ie:

$$£60,000 \div £50 = 1,200 \text{ residents}$$

Thus, fire units costing £60,000 per annum are warranted for high risk communities of 1,200 or more persons.

In the case of communities with a medium reported annual rate of fire of (say) 0.0022 per dwelling, the cost of £60,000 is divided by £36 to give 1,680 residents per unit.

Estimations of the number of residents required to satisfy current Government guideline on cost-effectiveness are provided for the three different fire cover options and risk ratings (very high, high, medium and low) in Table 2.3 for a 11-15 minute response time. The adoption of a faster (6 to 10 minutes) response time does not significantly alter the results.

This calculation has been completed for the three different values of life previously noted. The findings for the current guideline value of £850,00 are summarised below for High and Medium risk areas as examples. The full results are shown in Table 2.3.

High risk area

Thus, if the current guideline of £850,000 per averted death is applied:

- the risk to life experienced by High Risk communities of 1,700 residents warrants Standard Retained units,
- the risk experienced by High Risk communities of 1025 or more residents warrants a unit corresponding to the Case for Change,
- the risk experienced by High Risk communities of 600 or more residents warrants Partly Retained unit.

Medium risk areas

Thus, if the current guidelines of £850,000 per averted death is applied:

- the risk to life from fire in the home experienced by Medium risk communities of 2,800 residents warrants Standard Retained units,.

- the risk experienced by Medium Risk communities of 1,680 or more residents warrants a unit corresponding to the Case for Change,
- the risk posed by Medium Risk communities of 980 or more residents warrants Partly Retained unit.

Table 2.3: Number of residents required to achieve each level of cost-effectiveness (11-15 mins response time)

Risk rating / Cost per life saved	Annual cost per unit								
	£35,000			£60,000			£100,000		
	£425,000	£850,000	£1,250,000	£425,000	£850,000	£1,250,000	£425,000	£850,000	£1,250,000
Very high	450	225	150	780	390	260	1300	650	430
High	1200	600	400	2000	1025	690	3400	1700	1150
Medium	1950	980	660	3350	1680	1150	5600	2800	1900
Low	14,000	7000	4600	24,000	12000	8,000	20,000	20,000	13,000

2.3.5 Guidelines on expenditure per n head of population

Another way of matching fire cover to the level of risk is to determine the “value of life” that can be saved by fire cover for communities of different sizes, based on £850,000 per averted death. This calculation has been completed for communities of under 975 persons, ie those which are not large enough for currently proposed upgraded standard of volunteer fire cover. This is shown below for the medium and high risk rating and assuming an effective (life saving) response can be mounted in 11-15 minutes. Thus, the risk to life experienced by a medium risk community of 200 persons warrants about £7000 p.a. of expenditure on fire cover.

Clearly this raises the question how a life saving response can be achieved at these costs. Options such as partnering with other emergency services or development of an alternative form of fire cover would need to be identified.

Table 2.4: Annual expenditure warranted for averting fire deaths in smaller communities

Community size (persons)	Fire risk rating	
	Medium risk	High risk
100	£3600	£5900
200	£7000	£11800
300	£10700	£17700
400	£14300	£23600
500	£18000	£29500
600	£21400	£35300
700	£25000	£41200
800	£28600	£47100
900	£32000	£53000

2.4 Community fire safety

The level of expenditure that is required for the purpose of community fire safety is uncertain, due to limited research on the impact of alternative levels and types of fire safety initiatives on loss of life. However, experience elsewhere tends to suggest that a concerted community fire safety initiative can significantly reduce the number of fire deaths in an area, perhaps by as much as 50%. Assuming a willingness to expend up to £850,000 per life saved this would suggest that an expenditure of about £850,000 is reasonable for each pair of preventable fire deaths currently reported in an area. However, experience elsewhere, as reported in “Safe as houses”, also suggests that an effective community initiative can be achieved at a fraction of these costs, at about £100,000 per life saved. Therefore, a cost of £100,000 to £850,000 per pair of preventable fire deaths may be used as a guideline until further information becomes available - factoring this value by the average number of preventable deaths per year in an area.

2.5 Road Traffic Accidents

The JCACR research concluded that it is not appropriate for a set of guidelines regarding the tolerability of risk posed by road traffic accidents or other incidents entailing extrication of casualties by the fire service to be applied to the fire service - as it does not have regulatory primacy in this area. However, it did indicate that the level of fire cover should take account of the number of incidents entailing extrication of casualties. As with fire risk, the level of cover that can be warranted is linked to a value per life saved. However, in the case of RTAs it is difficult to apply a single value of life for the following reasons:

- the degree of injury and risk to life experienced by casualties extricated by the fire service in RTAs etc is uncertain due to the limited amount of research in this area,
- it is not clear whether the estimation of the cost incurred in saving a life should include the costs incurred by all of the emergency services who are involved in incidents or whether it should be restricted to those incurred by the fire service costs,
- the NHS Executive regarded a cost of £50,000 per life saved to be reasonable for the provision of life saving Ambulance Services in rural areas,
- values of £100,000 per major injury being averted are commonly applied to public safety decisions.

Therefore, it is difficult to recommend a single value of life for RTAs. However, it is reasonable to suggest that the value per extrication would be in the range of £50,000 to £850,000.

If it is accepted that it is justified to expend at least £50,000 per attendance (as per Ambulance Service costs per life saved in rural areas), the regular occurrence of 2 or more incidents warrants retained cover, 1 per year warrants the higher cost auxiliary option and 1 every two years just about warrants the lower cost auxiliary option (if allowance is made for other incidents).

If the highest possible value per extrication is applied, say £850,00, this would tend to indicate that the cost of a retained unit is warranted in all areas experiencing a RTA extrication once every few years. However, it is recommended here that the former value is applied until the severity of RTAs is clarified.

In the case of sparsely populated areas, it is envisaged that the number of RTAs entailing extrication is estimated in each area, such as each village. The number of incidents should be compared against these guidelines and an appropriate level of cover identified. In those cases where the area already warrants fire cover on the grounds of dwelling fires, this would serve to reinforce that conclusion. However, in cases where the fire risk does not warrant fire cover in its own right, it would be appropriate to recommend provision of fire cover on the basis of extricating persons from RTAs etc alone.

As with fire cover, these guidelines indicate the maximum level of expenditure that can be warranted rather the cost that must be incurred. It would be acceptable to provide a different lower cost type of fire cover if this alternative is capable of safely extricating casualties in the required time. The JCACR research suggested that a response to an RTAs should aim to allow medical care to be rendered to casualties within the “golden hour”, requiring brigade attendance within about 10 minutes and extrication within about 20 to 25 minutes of arrival.

2.6 Summary of guidelines

In the context of sparsely populated areas, the main points are:

1. The risk in areas with a rate of fire death above 1 in 50,000 per person per year is classed as intolerable and should be reduced by a mixture of fire cover and community fire safety.
2. The level of expenditure that is required for the purpose of community fire safety is uncertain, due to limited research in this area. However, it would be reasonable to use a value of £100,000 to £850,000 per life saved as a guideline until further information becomes available. Experience elsewhere tends to suggest that the lower cost is sufficient.
3. The type of fire cover that can be warranted depends on the number of residents in an area and the rate of fire. For example, in areas with a medium rate of fire unit:
 - 980 residents warrant a Partly Retained Volunteer unit,
 - 1680 residents warrant a unit corresponding to the Case for Change,
 - 2800 residents warrant a Standard Retained Fire unit.
4. The minimum number of RTA and other incidents entailing extrication of casualties required to warrant each type of fire unit is:
 - 1 every 2 years for Partly Retained Volunteer unit option,,
 - 1 per year for the Case for Change option,
 - 2 or more per year for Standard Retained Fire unit option.

3. PART 2: STEP 1 ESTIMATION OF RISK LEVELS IN SPARSELY POPULATED AREAS

3.1 Overview

This section first aims to calculate the rates of fire, fire casualty and fatality rates in the 10 Highlands and Islands districts and the Isle of Mull. The rates of fire and casualty are used to categorise the risk from fire in these areas. The tolerability of risk is then considered and an indication is given of the level of risk reduction required for tolerable risk levels to be achieved. These rates are used later in section 4 of this report to indicate the level of fire cover required to reduce risk to tolerable levels. In addition, we use the estimated rate of fire in section 5 of this report to calculate the cost per life saved, to provide an assessment of the type of fire cover that can be warranted.

We have also compared the reported rates of fatality to predicted (by the application of the national model) fatality rates. The aim here is to gain an indication of whether the national model provides an accurate measure of risk in sparsely populated areas, thereby allowing greater confidence to be placed in the predicted benefits of alternative types of fire cover. However, as noted in the introduction, the number of reported fire deaths in the study are too few to allow any definitive conclusions to be reached on the validity of the national model. Accordingly, we have also considered the circumstances of a number of actual fire deaths, in section 4, to determine if there is any evidence that a faster or better equipped response may have averted one or more fire deaths. Such evidence would support the view that there is a relationship between response times and fatality rates in sparsely populated areas.

Key findings:

1. The predominant risks to life include fire in the home and RTAs.
2. It is possible to estimate rates of fire and casualty by considering a 4 year period. However, it is necessary to look at the population as a whole in sparsely populated areas due to the small numbers resident in any one village or district. 67,000 of the 274,000 residents in Highlands and Islands are in areas served by volunteer units. Also, the small number of fire casualties reduces the reliance that can be placed on this statistic as an indicator of the risk.
3. The rates of fire and fire casualty do not agree, with a medium rate of fire and a low rate of fire casualty. The low number of reported fire casualties suggests that greater reliance should be placed on the rate of fire per dwelling.
4. Based on the rate of fire per dwelling, the risk from fire in the home would be classed as medium for those areas in the Highlands and Islands region served by volunteer units. The high fatality rate in these areas is consistent with the predicted rate of fatality for areas with a medium rate of fire and a relatively low level of fire cover - thereby supporting the

view that the rate of dwelling fire is a more accurate indicator of the risk than the fire casualty rate.

5. Over the 4 year sample period the rate of fire death in dwellings is about 1 in 38,000 in those parts of Highlands and Islands served by volunteer units, compared to 1 in 49,000 for the Highlands and Islands as a whole.
6. The fatality rate is one of the highest for any region of the UK and would be classed as intolerable according to the guidelines developed by research completed for the JCACR.
7. There were about 43 rescues of casualties from RTAs and other emergency incidents (other than fire) in areas served by volunteer units in the Highlands and Islands in the year April 1997 to March 1998, compared with about 1 rescue per year from dwelling fires. These incidents occur mainly in those areas with relatively larger communities.

3.2 Overview of survey areas

3.2.1 Highlands and Islands

The Highlands and Islands fire brigade is split into 10 districts, with a total population of about 270,000 persons - of whom about 67,000 reside in areas served by volunteer fire units. This includes three sets of islands, namely Orkneys, Shetland and Western Isles. In addition to a single whole time station in Inverness there are 28 retained units and 98 volunteer units, three of which are being upgraded to retained units. The volunteer units are a mix of mobile and non-mobile units serving communities ranging in size from under 100 to a few thousand persons. Many of these communities are on islands served by ferries or are over 1 hour drive from the nearest retained unit. These areas are predominantly residential, with a few hotels, local amenities (such as shops and halls) industrial units and forestry - although some areas have a significant throughput of traffic and special sites such as historic sites and harbours for passenger ferries. The communities served by each unit are shown in Appendix B.

3.2.2 Mull

Mull is served by a 2 pump retained station at Tobermory and 4 volunteer units at Salen, Craignure, Bunessan and Iona. Salen is an equipment dump whilst Craignure and Bunessan are mobile units (1 midi water tender and 1 volunteer support unit respectively) with stations which are similar to the Partly Retained Volunteer fire unit option. Iona is a mobile unit (Ford P100 Pick-Up) with a garage. All units except Salen have BA. There are police and navy helicopters and lifeboats in Obon on call for transport of specialist officers for, e.g. chemical incidents. There is also an arrangement with the local ferry for conveyance of appliances, which takes 45 minutes to cross from Obon.

There are about 3,140 residents on the 996 km² island, which is approximately 25 miles north to south and 28 miles east to west. The population numbers have been slowly increasing in recent years. There are no special risks, except some fuel oil storage at Craignure, 2 or 3 distilleries in Tobermory and the Iona Abbey on Iona, with a predominantly hilly terrain and a

population concentrated in coastal villages and hamlets. There are about 30 to 40 non-residential premises outside of Tobermory, mostly hotels and shops catering for tourism, plus numerous farms and other low occupancy buildings such as churches. The Iona Abbey is reportedly visited by very large numbers of tourists each year. There are about 123 km² of forestry on Mull.

3.3 Estimating rates of fire and casualty

3.3.1 Aims

Estimates of the rates of fire, fire death and fire casualty are required for two purposes. Firstly they are used to consider the tolerability of risk in an area, by comparing the rates against the benchmarks and risk criteria noted in section 2. Secondly they are subsequently used to categorise the rate of fire/casualty as Low to Very High.

The three statistics (fires, fire deaths and fire casualties) are used in combination to assign a category rather than relying on any one statistic. In particular, reliance is not placed on casualty rate data alone due to the small numbers of casualties typically reported in small or sparsely populated areas. The concern here is that the rate of casualty may be overly sensitive to the period sampled, with the possibility of a single year skewing the data. This is demonstrated by the case of Mull, where the rate of fatality varies enormously depending on which period is considered. In addition, there is also concern that fewer persons are advised to have precautionary check ups in remote rural areas due to the long travel times to hospitals, compared to urban areas and towns on which the classification of casualty rates is based. Greater reliance is therefore placed on the rate of fire due to the relatively larger number involved and the rate of death which is not considered to be so susceptible to spurious statistical or reporting variations.

Having assigned a risk category to an area the national model of response times-fatality rates is applied in section 4 of this report to indicate how alternative levels of fire cover may influence the risk of death.

3.3.2 Highlands and Islands as a whole

Highlands and Islands, with a total population of 274,624 in 1995, had the highest rate of death per million residents in dwelling fires in UK in 1996 (jointly with Strathclyde) at 25 deaths per million persons (pmp), i.e. 1 in 40,000 residents. This is:

- more than double the rate of death (in dwelling fires) for UK as a whole, which was 10 pmp in 1996,
- exceeds the rate of death in 4 out of the other 7 Scottish brigades by more than 50% in 1996, and:
- is 30% higher than the average for Scotland as a whole, i.e. 25 pmp vs 19 pmp.

A detailed breakdown of the number and annual rates of dwelling fire and fire casualty per n residents is given in Table 3.1. The risk would be classed as medium to high based on casualty and fire rates, but almost intolerable according to rate of fire death. The observation of a very high fatality rate is consistent with a medium to high rate of fire when account is taken of the response time in the Highlands and Islands. This can be illustrated by referring back to figure 2.1, the national statistical model of the relationship between response times, rates of fire/fire casualty and fatality rates. This model predicts a fatality rate of just above 1 in 50,000 per person in medium-high risk areas with a response time in the range of 11 to 20 minutes.

This would indicate that a significant reduction in fire risk in the home would be required to bring risk down to levels reported elsewhere in Scotland and the UK as a whole, as well as to reduce risk to the level classed as tolerable within the JCACR research.

Virtually all fire deaths in Highlands and Islands are in houses, namely 5 out of 7 fire deaths in 1994-95, with 1 in a flat and 1 in a hotel/boarding house. Six out of the seven fatal casualties were aged over 60 in 1994-95 reflecting the high number of elderly people in the surveyed sparsely populated area, who are commonly known to be at particular risk from fire.

Table 3.1: Summary of dwelling fires and casualties for whole of Highlands and Islands (1992-1996).

	1992	1993	1994	1995	1996	Average number p.a.	Average annual rate per n persons
Deaths	7	6	5	3	7	5.6	1 in 49,000
Non-fatal casualties.	17	21	59	34	44	35	1 per 7,864
Rescues	10	5	31	27	22	19	1 per 14,454
Sub-total	34	22	95	64	73	57.6	1 per 4,768
Dwelling fires	271	297	303	322	284	295	*1 in 930

*If it is assumed that there are about 120,000 dwellings (i.e. about 2.3 residents per dwelling) the rate of fire per dwelling is about 1 per 400 dwellings compared to an average UK rate of 1 per 2000 dwellings.

The ratio of fatal to non-fatal casualties is 1 to 10 in Highlands and Islands compared to 1 to 24 for the UK as a whole and 1 to 17 in Scotland, suggesting that either a higher than average proportion of fire casualties suffer fatal injuries in the Highlands and Islands or that there are differences in reporting practices between Highlands and Islands and other brigades, i.e. fewer persons involved in fires are reported as casualties or rescues.

3.3.3 Dwelling fire and casualty rates in areas served by volunteers

Dwelling fire risk has firstly been estimated separately for each of the 10 Highlands and Islands districts and then for the 10 districts as a whole. It is argued that, due to the small numbers of fires and casualties involved in each district, inter-district variations in rates of fire and casualty should, on the whole, be treated with great caution. Therefore, whilst district and station specific numbers and rates of incidents are given in Appendix B, the fire risk in areas served by volunteer units is rated as a whole for the purpose of this review. In addition, due to the small numbers of residents on Mull this area is categorised along with the Highland and Island areas.

Estimated rates

The annual rates of fire, casualty and death for the 67,000 residents in areas covered by volunteer units in Highlands and Islands in the 4 year period 1994-1998 are:

Rate of dwelling fire per resident = 1 in 1048 residents, i.e. about 1 per 450 dwellings.

Rate of dwelling fire casualty = 1 per 8,388 residents.

Rate of dwelling fire death = 1 death per 38,345 residents

Comparison of rates between volunteer areas and rest of Highlands and Islands.

The fatality rate is higher in areas served by volunteer units than in the Highlands and Islands as a whole despite a similar rate of dwelling fires and a lower fire casualty rate. This suggests that the likelihood of death per fire is greater in areas served by volunteer units than in other areas. Indeed, the ratio of fire deaths to fire casualties is 1 to 4.5 in areas served by volunteer units compared with 1 in 10 for the Highlands and Islands as a whole and a ratio of 1 in 24 for the UK as a whole.

This could be attributed to a number of factors. Some factors are speculated below:

- variation in reporting practices between rural and urban areas, with fire officers less inclined to advise on precautionary check-ups when the hospital is a long way away,
- the behaviour of residents and levels of fire safety could vary between these areas, with (say) fewer persons using smoke alarms in sparsely populated areas leading to longer fire discovery times,
- the time between fire discovery and reporting to the fire brigade may be longer due to a lower chance of a passer-by or neighbour being in the vicinity to notice a fire - although it should be noted that most people in sparsely populated areas reside in villages where residential housing is in close proximity,
- demographic variations, with (say) more elderly persons in sparsely populated areas who are vulnerable to the effects of fire and hence more likely to die per fire,
- differences in the level or capability of fire cover - with slower response times by less well equipped units in areas served by volunteer units.

It is difficult to verify whether there are significant differences in the behaviour of residents between remote rural areas and other areas with certainty at this moment without a more exhaustive survey of, say, resident behaviour in rural areas, which is beyond the remit of this study. However, the possible impact of local fire cover on fatality rates is considered further below.

Tolerability of risk

As with the Highlands and Islands as a whole, the fatality rate in areas served by volunteer units is much higher than elsewhere in Scotland and the UK, and falls into the area of risk classed as intolerable by the JCACR research. This would suggest that a significant reduction in the risk of fatality is required, through one or both of increased fire cover and fire safety, for tolerable levels of risk to be achieved.

Categorisation of rates

The classification of the risk, using the benchmarks developed as part of the JCACR research, varies according to which measures is used, as follows:

Rate of dwelling fire	-	Medium (but close to threshold between medium and high risk)
Rate of fire casualty	-	Low
Rate of fire death	-	High

In the case of Mull, there were no reported fire deaths or fire casualties in the period 1994-1998. This is not surprising given the small numbers of residents on Mull, namely 3,140. However, the rate of fire per persons was 1 per 632 per year in areas served, by which it would be classed as high. As previously noted though, it is advisable to categorise Mull along with the other areas served by volunteer due to the small population on Mull.

A high fatality rate is consistent with a relatively slow (10 to 20 minutes) response time in medium risk category areas, as shown in Figure 2.1. However, the rate of fire and rate of fire casualty are not consistent, raising the question of how the fire risk should be categorised. This is explored further below.

3.3.4 Review of rates of fire, casualty and death in areas served by volunteer units

The aim here is to conclude which risk category should be assigned to sparsely populated areas served by volunteer units, based on the rate of fire and rate of fire casualty statistics. There are a number of ways in which this conclusion can be reached. Firstly, the casualty rate could be dismissed as a spurious statistic due to the relatively small number involved and/or due to possible variations in casualty reporting practices (namely fewer precautionary check-ups). This would suggest that the rate of fire/casualty in these areas should be classed as medium. Secondly, the categorisation of an area can be tested by comparing the fatality rate

predicted by application of the national model in conjunction with each of the two statistics to the reported fatality rate, with the statistic which gives the closest match to the national preferred.

The comparison of predicted and reported fatality rates can also be used as an initial test of the validity of the national model in the context of sparsely populated areas served by volunteer fire units, ie does the predicted number of deaths agree with the reported number of fire deaths? In completing this comparison it should be recognised that it is not expected that there will be an exact match of predicted to reported deaths for two reasons. Firstly, as a general rule, it is expected that the current version of the national model will predict fatality rates in a particular area to within a factor of two only. Secondly, the reported fatality rate is likely to exhibit large variations due to the small sample size. Indeed, the national model is based on a sample of over 12,000 fires involving over 500 fire deaths compared to 7 fire deaths and 256 fires in the study area, suggesting that more statistical confidence can be placed in the national model than the sample of fires from sparsely populated areas..

Comparison against predicted number of fire deaths

There are a number of ways in which the reported fatality rate can be compared with the predicted fatality rate. The method of comparison depends on two considerations, namely:

1. whether to rely on the rate of fire or rate of fire casualty as an indicator of the risk,
2. whether or not to assume that current volunteer fire units are as likely to undertake a successful rescues from a dwelling fire (assuming the same response time) as those units on which the national model is based.

The national model of the relationship between response times and fatality rates is implicitly based on the response of retained and whole time fire units - as these account for the vast majority of attendances in the UK. These units obviously have a higher standard of equipment and training than current volunteer units, such as CABA, ladders and fire appliances. Therefore, it would be reasonable to suppose that volunteer units (which have not yet been upgraded) are less likely to manage a rescue than a retained or whole time unit which attend in the same time. This is supported by at least one case study in section 4 where a volunteer unit could not attempt a rescue due to lack of appropriate equipment, ie CABA and ladders. The implication of this line of thought is that current volunteer units should be equated with "no fire cover" for the purpose of predicting fatality rates in dwelling fires. However, a proportion of volunteer units have already been upgraded, with CABA and LFAs - suggesting that a proportion of units should be able to manage a rescue. Also, rescues are completed in certain circumstances by members of the public without CABA etc, such as where the level of smoke does not yet prohibit entry. Indeed, Highlands and Islands reported three rescues by volunteer fire units from dwelling fires in the 4 year sample period.

This would suggest that some allowance should be made for the life saving capability of existing volunteer fire cover, notwithstanding the concerns regarding the safety of volunteers when conducting such rescues. As regards the application of the national model, this would suggest that the reported fatality rate should be somewhere between the predicted fatality rate

for “no fire cover” (as indicated by a over 20 minute response time) and the average 11-15 minute response time reported for volunteer units.

The calculation can be completed twice, firstly using a fatality rate per fire and then using a fatality rate per fire casualty. Obviously the fatality rate per fire, for a given response time, is lower than the rate per casualty. These rates were derived in the JCACR research. Thus, for example, with a 16-20 minute response time, the rate of death per casualty is about 1 in 6 versus 1 per 15.5 per dwelling fire. Also, the rate of fire casualty per person is replaced by the rate of fire per dwelling.

Thus, there are four possible comparisons, as follows:

1. Low reported rate of fire casualty and “no fire cover”.
2. Low reported rate of fire casualty and a 11-15 minute response time.
3. Medium reported rate of dwelling fire and “no fire cover”
4. Medium reported rate of dwelling fire and a 11-15 minute response time.

The calculation method for case 4 is shown, using the actual response times for a sample of 79 attendances and the actual rate of fire per dwelling. The results are shown in table 3.3.

The fatality rate for “no fire cover” has been calculated by applying the fatality rate for an over 20 minute response to all fires, which is assumed to be the equivalent to “no fire cover”.

Table 3.2: Predicted number of deaths per year for Highlands and Islands volunteer areas (using the reported rate of dwelling fire and assuming volunteers are equally effective as other fire cover)

Response time (mins)	Proportion of dwelling fires attended (a)	Fatality rate per fire (national model) (b)	Reported rate of fire per dwelling (c)	Number of dwellings (d)	Predicted deaths per year. = a x b x c x d
<5	0.013	0.015	0.0022	30500	0.013
6 to 10	0.39	0.017	0.0022	30500	0.44
11 to 15	0.33	0.022	0.0022	30500	0.49
16 to 20	0.14	0.029	0.0022	30500	0.27
>20	0.127	0.064	0.0022	30500	0.55
Total	1.0	-	-	-	1.76

Table 3.3. Comparison of predicted versus reported fatalities.

Fire cover assumption	Reported rate of fire/casualty	
	Medium fire rate (1 per 450 dwellings)	Low fire casualty rate (1 per 8389 persons)
No fire cover	4.30	1.40
Average of 11-15 mins	1.76	0.57

Actual number of deaths is 1.75 per year in 1994-1998, plus 1 rescue per year.

The reported fatality rate coincides with the rate predicted by the medium dwelling fire rate and an average response time of 11 to 15 minutes. This is consistent with the view that the rate of dwelling fire is the more reliable statistics and that current volunteer units undertake rescues to some extent. This is considered to be a reasonable fit to the national model, especially given the small number of fire deaths involved and the uncertainty regarding the extent to which current volunteer units are able to undertake rescues.

The reported number of fire deaths exceeds that predicted by the low casualty rate even when a “no fire cover” assumption is applied. This is taken here to reinforce the view that the casualty rate is a less reliable indicator of the risk in this case, especially as some account should be taken of the life saving ability of existing volunteer fire units.

Thus, it is suggested that confidence can be placed in the national model and the rate of dwelling fire - although a larger sample is required to fully validate the national model.

3.4 Other premises

Information has been received for 3 districts on the type and number of persons occupying other types of premises in volunteer areas, principally hotels, local schools and shops, with an average of 30 persons per premise. The impact of these on the risk assessment is elaborated in section 5.

In none of the reported cases does the number of hotels, schools etc meet the criteria suggested in the JCACR research to constitute a significant risk in their own right. In addition, the fire casualty rate in hotels etc is much lower than in dwellings, with, for example, a single fire death in the UK in 1996 amongst about 30,000 hotels. Thus, with typically less than 30 other premises in each community, the likelihood of a persons reported fire per occupant is much less than for residents. Even if 100% occupancy of these buildings was assumed for the whole of a year, they would add no more than 10% to 20% to the population totals in most cases. Given that the risk of fire casualty is much lower than for dwellings, the addition of occupants of other premises would not as a rule significantly affect the estimated population totals for the communities.

3.5 Special services entailing extrication of casualties

Review of incident reports indicates that fires are just one of a number of emergency incidents involving threat to life and limb attended by the fire service. Indeed, deaths from fire comprise a small proportion of all those emergency incidents involving a threat to life or limb, with about four non-fire incidents involving casualties for every fire casualty. This indicates that fire is just one of many risks that need to be taken into account when considering the need for fire cover.

3.5.1 Highlands and Islands

The analysis of special services entailing extrication of casualties by volunteer units is complicated by the fact that attendance to these incidents has increased in recent years due to the upgrading of auxiliary units, such as the provision of fire appliances. That is, the number of incidents attended by auxiliary has increased because their increased mobility has made it possible for them to attend incidents. Whilst it is reported that there has been some increase in the number of incidents occurring in areas covered by auxiliary units, the rise in attendance is accounted for primarily by their increased mobility.

Considering 1997/98, there were, for all 10 districts:

- 5 casualties successfully rescued from incidents other than RTAs in areas attended by auxiliary units, and two deaths,
- 38 casualties extricated alive from RTAs, and 3 deaths, from a total of 28 RTAs in areas attended by auxiliary units.

i.e. about 43 persons rescued in 1997/98 in incidents in areas attended by auxiliary units.

This can be compared with 21 incidents attended in 1996/97 at which 22 survivors were rescued.

Whilst this gives an average of 1 incident per year for every 2 auxiliary units, the incidents are concentrated in a smaller number of areas. The location of these incidents has been analysed in greater depth to ascertain whether they coincide with the relatively more populated areas, as reported in section 3.

There were also 4 car fires involving fatalities. However, 2 of these deaths were suicides and the others died upon rupture of fuel tanks immediately after collisions, suggesting that they were unpreventable (by fire service intervention).

3.5.2 Mull

There were no RTAs involving extrication of casualties reported in the 4 years 1992-1996 in the areas covered by auxiliary units, except an fire appliance incident with 4 casualties in Salen. There were two reported RTAs in the period 1987-96, one at Salen with 4 casualties in

1991 and one at Buinessan with one fatal casualty, ie about one RTA every 5 or so years across the island.

4. PART 2: STEP 2 ACHIEVING TOLERABLE RISK LEVELS

4.1 Overview

Having established the risk levels in section 3, this section aims to identify the level of fire cover and community fire safety work required to reduce risk to tolerable levels. The rates of fire and fire death estimated in section 3 are compared with risk criteria and benchmarks to indicate what level of risk reduction should be sought. As a minimum the risk should be reduced to the level considered tolerable, less than 1 dwelling fire death per 50,000 persons per year. An even lower level of risk should be sought where this can be achieved cost-effectively. The extent to which the proposed level of fire cover will reduce risk sufficiently is considered, along with the need for a complementary community fire safety programme. The cost-effectiveness of these options is assessed in section 5.

What level of risk reduction is required?

A 30% reduction in deaths should bring the risk to a point just within the region of tolerability, ie below 1 in 50,000 as defined in the JCACR research. However, it should be noted that further reduction in risk is required once the risk has fallen to a tolerable level, wherever cost-effective means can be identified. Indeed, the rate of death of 1 in 38,000 per year, as reported in section 3, in sparsely populated areas needs to be reduced by at least 60% for it to fall to the UK average of 1 in 110,000.

What impact might a concerted community fire safety education initiative have on fire deaths?

Consideration of the circumstances of the 7 dwelling fire deaths in auxiliary Highlands and Island areas in 1994-98 indicates that the correct operation of smoke detectors could have averted 5 of the deaths, whilst a correct response to the fire (i.e. do not re enter the building) could have averted another death, i.e. the majority of the deaths were preventable. Examination of two fire deaths on Mull suggests that neither could have been averted by a faster emergency response.

The experience of other UK fire brigades, particularly, West Midlands, Northern Ireland and Lothian and Borders, tends to suggest that the number of fire deaths can be significantly reduced, possibly halved, by a well targeted and concerted community fire safety initiative over a number of years.

What impact would a higher grade fire cover on loss of life from fire in areas attended by volunteer units?

There are 1.75 reported fire deaths in homes served by volunteer units per annum in the Highlands and Islands. As discussed below, it is estimated that the current provision of volunteer fire units saves about 1 life per year in the Highlands and Islands. If all dwelling fires were attended in under 15 minutes by units able to conduct rescues another 0.5 to 1 lives

could be saved per year, i.e. one additional life saved every 1 to 2 years - a 25% to 40% reduction in fire deaths. However, as the cost-effectiveness analysis in section 5 indicates that this level of fire cover is warranted for only a proportion of units, serving 75% of the population, the reduction in loss of life would be at the mid point of the range, at about 30%.

The impact of fire cover on loss of life has been predicted in two ways, namely:

1. Statistical prediction using national data on relationship between response times and fatality rates.
2. Examination of fatal fire reports from Highlands and Islands.

The statistical prediction suggests that the auxiliary standard of fire cover should reduce loss of life by 25% whilst the case studies suggest a potential 40% reduction.

Conclusion

The improvement of community fire safety has the potential to avert the largest number of fire deaths in sparsely populated areas. Notwithstanding this, the achievement of a 11-15 minute response by units capable of undertaking rescues should reduce risk to the boundary of intolerable-tolerable risk. However, the risk would still be above the national average and in the region regarded by the JCACR to require further risk reduction. Further risk reduction would require a reduction in the rate of fire and/or fire casualty by increasing the level of community fire safety. The impact of fire cover and community fire safety is not wholly additive, with improvements in one reducing the potential impact of the other. However, an improvement in both areas is required to reduce risk to tolerable levels.

4.2 Impact of fire cover and fire safety

4.2.1 Case studies

Highlands and Islands

The circumstances of the 7 fire deaths are given in Table 4.1. The 5 fatal dwelling fires reported for 1994-98 in areas served by volunteer units suggests that 6 of the 7 deaths might have been prevented by correct operation of detectors and/or correct action of occupants, whilst 3 out of the 7 deaths might (but not definitely) have been averted by a faster response of a fully equipped unit. In particular,

- A rescue could have been attempted about 8 minutes earlier in a case where a victim re- entered a house. The victim was reported to be inside 8 minutes before the brigade arrived. This report was issued 10 minutes after the fire was reported. The unit would have arrived at the time the first report was issued that he was inside if mobilisation had taken 5 minutes instead of the reported 13 minutes.
- A rescue could have been attempted about 15 minutes earlier of 2 victims who had been seen at a 1st floor bedroom window - if a mobile CABA team was available in place of a non-mobile volunteer unit.

These three deaths might have been averted by improved fire safety, such as smoke detectors.

In contrast, a faster response is unlikely to have altered the outcome in the next cases:

- 1 intoxicated victim ignited himself and failed to respond to smoke alarms,
- 1 elderly person died in a fire reported by passer-by an unknown (long) time after ignition,
- 2 occupants at Kilchoan failed to respond to neighbours knocking and were probably dead or incapacitated by the time the fire was discovered by passer-by. Smoke was issuing from every window at the time of fire discovery.

Thus, 2 or 3 of the 7 victims might have been saved by a faster response, i.e. a 30 to 40% reduction in deaths, whilst 85% (6 out of 7) might have been saved by improved fire safety, assuming the death of the intoxicated victim was unpreventable.

Mull

There have been two fire deaths on Mull since 1987, one in 1987 and one in 1991. As outlined below, in both cases the victims were intimate with the location of the fire and did not appear to be able to respond to the fire. In neither case does it appear likely that a faster emergency response would have been of benefit.

The 1987 fire was attended in 1 and a half hours from first call, having been discovered by a person about 5 to 30 minutes after ignition and reported 6 minutes after discovery, ie it was reported at least 11 minutes from ignition. The fire involved a log igniting loose covering of a chair in a bedsitting room, in which the elderly victim died. The whole house was destroyed by fire.

The 1991 fire involved a known heavy smoker living in a caravan who is thought to have accidentally ignited his foam cushion seating by dropping a lighted cigarette. The victim was under the influence of alcohol and was allegedly sniffing petrol fumes when last seen. The recumbent position of the body indicated that he may have been semi-conscious at the start of the fire. The fire completely destroyed the caravan.

Table 4.1: Summary of fire deaths in Highlands and Islands auxiliary areas (1994-98)

Incident number	Response time (from first call to brigade)	Summary	Comments
7194, Caithness	26 mins	Accidental fire, caused by faulty tumble dryer, reported in first floor storage room of wooden extension to 2 storey house at 03.56. Smoke alarms failed to operate, battery disconnected/no battery - 3rd alarm not in affected area. Fire spread from dryer to timber linings and other combustibles in utility room across ceiling and into stairway enclosure - blocking hallway. Father jumped from 1st floor window and re-entered back door to attempt rescue of child heard screaming in bedroom across hall from father's bedroom. Father and child both died, found on floor near to the window. Mother, who had been sleeping downstairs, escaped by back door. First attendance by auxiliary team. They used neighbours ladder to reach bedroom where fathers hand was last seen at window by neighbours but as they lacked CABA they were unable to enter. They were followed by retained unit 8 mins later. 4 CABA used by retained unit, 2 entered child's bedroom and removed both casualties by 1st floor window to 105 ladder.	<p>“Had a detector been fitted in the 1st floor landing this would have operated at a very early stage of the fire and the outcome may have been different”.</p> <p>It is possible that a faster attendance by a fully equipped unit may have changed the outcome as the two victims had attempted to shelter from fire, and mother had escaped - i.e. the victims were alive at the time the fire was reported.</p> <p>The non-mobile volunteer unit in Dunbeath was about 3 miles from the house but took 25 minutes from mobilisation to attend.</p>
5507, Ross	Late fire call - over 2 hours between discovery and first call.	Incident dealt with by police, fire extinguished before brigade arrival. A successful suicide attempt by occupant of car who doused himself and passenger compartment with petrol and ignited same.	An unpreventable fire death - suicide in disused quarry.

Incident number	Response time (from first call to brigade)	Summary	Comments
5461, Shetland	20 minutes	Accidental fire caused by faulty thermostat on electric blanket in bungalow bedroom discovered at about 06.00 by person. Bedding ignited. Single elderly (aged 80) resident died. Building completely destroyed by fire. No fire alarms were fitted. The victim was found in the living room.	A smoke alarm may have be of benefit as the victim was in the living room, whilst fire started in bedroom. Given probable delay in reporting, it is unlikely that a faster response would have changed the outcome.
00713, Drummadrochit	14 mins	Car fire in ruptured fuel tank caused by RTA discovered immediately and reported in under 5 minutes. All 3 occupants died, 2 from fire.	Unlikely that faster attendance would have changed outcome due to rapid onset of fire from ruptured car fuel tank.
2319, Ross	12 mins	Sitting room house fire caused by lighted cigarette at about 20.00 reported in 5 to 30 minutes from ignition. Fire ignited clothing of sleeping single elderly victim, aged 70, causing 40% burns to upper body. Minimal fire spread - contained to victims clothing and 1m ² of carpet. Fire detected by mains supplied smoke detector. The occupant did not apparently respond to alarm due to state of intoxication but neighbours were alerted. Neighbours smothered fire.	Unlikely that faster attendance would have changed outcome due to ignition of victims clothing and inability of intoxicated victim to respond. Fire extinguished by neighbours before brigade arrival. As alarm already fitted death could only be avoided by change in victims behaviour, i.e. more careful use of smoking materials.

Incident number	Response time (from first call to brigade)	Summary	Comments
1175, Kilchoan	24 mins	<p>Accidental house fire, discovered at 06.55 in kitchen caused by radiated heat from diesel stove ignited light weight timber partition. Leaking fuel from feed pipe fed fire. Fire spread from kitchen through lounge and to 1st floor bedroom and roof space. Both of the elderly (aged 83 and 84) victims were found in the bedroom. No smoke detectors. Fire was discovered over 30 min from ignition and reported 5 to 30 mins later.- i.e. probably burning for over 30 mins before first call to brigade. Smoke was issuing from every window on detection by a person staying in nearby caravan. Neighbours knocked on doors and windows but had no reply. Volunteers found 2 dead on arrival.</p> <p>First attendance by non-mobile auxiliary unit followed by auxiliary unit with light fire appliance. Third attendance by retained crew.</p>	<p>“It is possible that the presence of a smoke detector would have alerted the occupants at an early stage of the fire given the direction of smoke travel.”</p> <p>It is probable that the victims were dead at the time the fire was discovered by the passer-by.</p>
8717, Isle of Lewis	35 mins - late fire call	Car fire due to unknown cause - single fatality. Reported over 30 mins after ignition.	Unlikely that faster attendance would have changed outcome due to late fire call and probable rapid spread of fire in car.
5358, Aberchalder	12 mins	Car fire caused by head on collision. 1 occupant died and other pulled from vehicle by passer-by.	Unlikely that faster attendance would have changed outcome due to rapid onset of fire from ruptured car fuel tank.

Incident number	Response time (from first call to brigade)	Summary	Comments
7999, Isle of Barra, Castlebay.	15 to 18 mins	<p>Fire in ground floor bedroom caused by careless use of smokers materials (pipe) ignited bedding at about 01.00, reported at 01.18. No fire alarm fitted. Fire spread rapidly due to internal and external doors left open and internal partitions constructed of 60mm timber framing with hardboard finish. Fire fanned by strong wind and open window. One elderly fatality (aged 88) and 2 non-fatal casualties (aged 44 and 87). All three occupants left the property but the victim re entered to search for his daughter who he wrongly thought may be inside. He was reported inside at 01.28 (8 minutes before the brigade arrived at 01.36) and 10 minutes after the fire was reported. The mobile volunteer unit (LFA) took 13 minutes to mobilise and 5 minutes to travel to the fire. Fire caused extensive damage to ground floor and smoke damage to 2nd floor.</p>	<p>Fitting of smoke detectors may not have altered outcome, unless it allowed extinguishment of fire before it had developed, as victim re entered building after discovery. Also, education in correct response to fire, i.e. do not re enter, may not have altered outcome, as he thought his daughter was inside. However, education about fire risks of smoking in bed may have prevented fire.</p> <p>It is not certain whether a faster response may have altered the outcome, as the time of re-entering the property and the time of death are unknown. However, it is possible that an earlier arrival (ie within 10 minutes) may have allowed a successful rescue. With 5 minutes travel time from the station, a standard mobilisation time of 5 minutes would have allowed arrival 8 minutes earlier, ie at the time the police reported the father to be inside but 18 minutes arrival discovery of the fire.</p>

4.2.2 Statistical prediction for Highlands and Islands fire cover

The number of lives that could be saved is predicted by application of the national model and the dwelling fire data shown in section 3.

Application of the statistical model indicates that if all dwelling fires were attended in under 15 minutes, this would reduce the number of deaths by about 25%, from the reported 1.75 deaths to a predicted 1.3 deaths per year. This is predicted by assuming that:

- the 0.14 proportion of fires currently attended in 16 to 20 minutes are instead attended in 6 to 10 minutes, and;
- the 0.13 proportion of fires attended in over 20 minutes are attended in 11 to 15 minutes.

ie a ten minute reduction in average response times. This reflects the use of pagers reducing mobilisation time and the availability of LFAs reducing travel time.

The medium fire rate of 1 per 450 dwellings derived in section 3 has been applied for this calculation, as shown in Table 4.2.

Table 4.2: Predicted number of deaths with 11-15 maximum response times

Response time (mins)	Proportion of dwelling fires	Fatality rate per fire (national model) (b)	Rate of fire per dwelling (c)	Number of residents	Predicted deaths p.a.
<5	0.013	0.015	0.0022	30500	0.013
6 to 10	0.53	0.017	0.0022	30500	0.60
11 to 15	0.46	0.022	0.0022	30500	0.68
16 to 20	0.0	0.029	0.0022	30500	0
>20	0.0	0.064	0.0022	30500	0
	1.0				1.3

If the estimation of 3.6 lives saved in 4 years by existing cover is added to the predicted 0.9 lives saved by upgraded cover, the proposed level of cover should save about 1.5 lives a year in total. It can also be noted that the predicted number of deaths for a maximum 11-15 minutes response time is 1.3 compared to 4.3 predicted for the “no fire cover” scenario in Table 3.3, i.e the national model would predict that about 3 lives would be saved each year by this level of fire cover. These two estimates, of 1.5 versus 3 lives saved per year, are considered to be in reasonable agreement for such a small population

However, it should also be noted that this estimate is based on all volunteer units being upgraded to one or another of the proposed standards. As discussed in section 5, it is would be cost-effective to upgrade only a proportion of units, serving about 75% of the population.

Thus, the actual number of additional lives saved would be less, at about 0.34 per year instead of 0.45, ie a 20% reduction in loss of life.

4.2.3 Statistical prediction for additional fire cover on Mull

A sample of 4 attendance times by Mull volunteer units indicates attendance to dwelling fires in 17 minutes, 25 minutes, 1 hour 4 minutes and 18 minutes. It is reasonable to suppose that an improvement in response times for the majority of FDR fires from 17-25 minutes to under 15 minutes would achieve approximately same level of risk reduction for Mull as for the Highlands and Islands, ie a 25 to 40% reduction in the risk of fire death.

5. PART 2: STEP 3 IDENTIFYING COST EFFECTIVE LEVELS OF FIRE COVER

5.1 Overview

Having established that there is a need to reduce risk in section 4, this section of the report aims to identify which of the three fire cover options outlined in section 1, if any, meets the standard of cost-effectiveness for the various communities served by volunteer units. This is achieved by identifying those communities where the cost-per life saved of one or another option complies with the current Government guideline on cost-per life saved, namely £850,000 per life. The sensitivity of the conclusion to a variation in the cost per life saved guideline is tested by varying the value by about £425,000. It should be noted that this analysis aims to establish the maximum cost that can be warranted, as a rule, on the grounds of saving life, where such expenditure is required to deliver the service. This should not be interpreted as a requirement to incur such levels of expenditure. Thus, for example, where the analysis indicates that a retained unit can be warranted the lower cost "Case for Change" type of unit would be equally acceptable if it is equally practical and able to achieve the response standard

In addition, the frequency of RTAs has been considered for each community to determine the level of cover warranted on the grounds of extricating casualties from RTAs and other similar incidents. As these incidents mostly occur in the relatively larger communities, this part of the assessment focuses on how incorporating RTAs into the analysis alters the level of fire cover warranted on the grounds of fire risk.

In those cases where one or another of the current options do not meet the expenditure guideline, further more cost-effective options should be sought. To this end a number of possibilities have been identified within this study, such as partnering with other emergency services. The practicality, cost and operational acceptability of these options requires further study before they can be considered further. Such work is beyond the remit of this study.

The potential benefits of improved community fire safety are not taken into account in the assessment of fire cover. Clearly a successful fire safety initiative should greatly reduce the need for fire cover. However, it is not certain that a community fire safety programme will be implemented or that it will have the desired outcome. Also, fire cover is required for extricating casualties at RTAs and other special services incidents, which account for 4 times as many casualties and rescues as dwelling fires in the Highlands and Islands. These incidents occur mainly in those relatively larger communities whose dwelling fire risk warrant one or another of the three fire cover options.

What is the estimated cost per life saved for upgraded volunteer units?

The cost per life saved can be estimated in two ways. Firstly, the cost can be based solely on the marginal difference in loss of life between the current standard of volunteer cover and the proposed standard. In this case, with one additional life saved every year or two, changing all

98 Highland and Island volunteer units to retained and/or Case for Change type units according to Highlands and Islands fire cover review proposals, this would be achieved at a cost in the order of £5M to £10M per life saved.

However, the cost per life saved can also be calculated on the basis of the total number of lives that the proposed standard of cover should save. This latter approach is consistent with the view that the choice is between “no fire cover” and the new standard of fire cover, on the grounds that the current standard is unacceptable due to the risk posed to volunteer fire fighters. Moreover, this approach is more consistent with the aim of the study, namely to indicate the type of cover warranted for an area, which may be higher or lower than the existing fire cover.

When allowance is made for all of the lives that the fire cover should save, the cost per life saved of providing a mix of 98 retained and Case for Change units in the Highlands and Islands falls to about £2.5M to £5M per life saved - which is still above the current guideline.

However, the cost per life saved would vary greatly according to the size of the community. The size of communities served by volunteer units varies greatly from 60 residents to 3,500. A more selective match of upgrades to the size and risk rating of communities would satisfy current Government guidelines regarding cost per life saved. The cost per life saved has been calculated, as explained in section 2, for each fire cover option for a medium risk assumption, applying the £850,000 value of life. This indicates that communities of:

- 1,680 residents warrant a £60,000 Case for Change type of unit,
- 980 residents warrants a £35,000 Partly Retained Volunteer unit.

The location of RTAs, other life threatening special services and other types of premises such as hotels has also been examined. In the main they coincide with the relatively more populated areas. However, in some cases RTAs occur in communities of 980 to 1,680 persons, adding weight to the case for having one or another of the Case For Change or Partly Retained Volunteer units in these areas.

Conclusions

The application of these guidelines indicates that, in the case of Highlands and Islands, the dwelling fire risk warrants the expenditure required for one or another of the three fire cover options in 37 cases. As some communities are within 11 to 15 minutes of each other, this figure of 37 units allows for overlaps between volunteer units. This comprises 4 retained units, 10 Case for Change units and 23 Partly Retained Volunteer units - at a total capital cost of about £7m and annual revenue cost of £1.2m. This number could fall by about 8 if existing retained or whole time units are able to attend some of these communities in the required response time, reducing capital and revenue costs by about £1.2m and £250,000 respectively. Over 75% of the residents (ie about 50,000 residents) in sparsely populated areas of Highlands and Islands would be served by these units.

All of the communities served by volunteer units on Mull are of less than 1,680 residents, with only 160 on Iona. If allowance is made for potential RTAs, a Partly Retained Volunteer fire unit could be warranted in one of the communities on Mull, namely Salen. The annual cost of Partly Retained Volunteer Units at Craignure and Bunessan would be need to be about £10,000 less than assumed here (ie about £25,000 each p.a) for them to satisfy the cost-effectiveness guidelines applied in this study. It would need to be accepted that a single unit would be able to effectively contain spread of fire at Iona Abbey and that the cost of such cover is warranted for the Abbey alone for a unit equipped with a LFA and garage to be recommended on the grounds of protecting the Abbey.

Fire cover for smaller communities?

An alternative means of providing fire cover, more commensurate with the risk, is required for communities of less than 980 persons, indicating that the search for partnering opportunities should be a priority in smaller communities as well as the review of the make-up of fire cover for these communities. A review of other emergency services does suggest that there are some partnering opportunities. In addition, consideration could be given to:

1. **Domestic sprinklers:** It is pertinent to note that in the case of communities of less than 130 dwellings, the cost of installing domestic sprinklers in all dwellings would be less than the cost of maintaining an auxiliary unit over (say) 25 years.
2. **Non-mobile CABA equipped units:** It has also been suggested that some members of volunteer units could be equipped and trained with CABA and pagers, thereby improving their ability to undertake rescues. Whilst the exact costs and acceptability of this option have yet to be confirmed, the probable costs are likely to be within the cost-effectiveness guidelines for the majority of smaller communities.

Community fire safety education

The actual cost of an initiative tailored to the needs and circumstances of rural communities has yet to be estimated. Therefore it is not possible at this moment in time to estimate the cost per life saved by additional community fire safety work. However, it is possible to give an upper limit on the amount that could be warranted, if required.

If it is assumed that the upgrading of fire cover saves 1 additional life every two years in the Highlands and Islands, this would leave about 1 to 1.5 deaths per annum. Assuming a willingness to expend £850,000 per life saved this would suggest that an expenditure of about £1,000,000 can be warranted for community fire safety initiatives in those parts of the Highlands and Islands areas attended by volunteer units. This would increase to close to about £1.5m per annum if the volunteer units are not upgraded, due to the higher level of residual risk. It is again emphasised that this figures relates to how much could be warranted rather than how much is required to launch a community fire safety initiative. Experience elsewhere, as reported in "Safe as houses", suggests that an effective community initiative can be achieved at a fraction of these costs, at about £100,000 per life saved.

5.2 Highlands and Islands

5.2.1 Dwelling fire risk

The number of residents within each area served by volunteer units is shown in Table 5.2. Care must be taken in considering the results shown in Table 5.2 as a single unit might be able to serve more than one village. Therefore, the actual size of communities served by each unit (within 11-15 minutes) needs to be verified before reaching a firm conclusion about the match of population to guideline values. For example, a mobile unit at Dunvegan (Skye and Lochalsh district) can attend in under 20 minutes about 2,000 residents who are currently covered by four volunteer units at Dunvegan (1177), Waternish (300), Glendale (309) and Struan (228). Thus, a unit which may not “qualify” on basis of population in the immediate village, may qualify on basis of total population served (within required attendance time) in surrounding areas.

A colour code has been used to highlight those communities where the number of residents matches the guideline level for one or another fire cover option, as shown in Table 5.2, along with the number of units and residents. Blue, green and yellow indicate communities which warrant Standard Retained, Case for Change and Partly Retained Volunteer units respectively. Pink is used to indicate communities which would warrant Partly Retained Volunteer units if the higher value of life (£1.25m) is applied. Red and mauve is used to indicate communities where the cost per life saved exceeds the higher value of life (of £1.25m), with a medium and high risk rating applied respectively.

The results are summarised in Table 5.1 below. This shows that there are about 21 to 30 units which satisfy the guidelines applied here (for dwelling fire risk alone), which would serve 68% of the population. This leaves 51 to 55 units in communities accounting for 32% of the population with insufficient residents to satisfy the guidelines applied here. A check would need to be made on the attendance times of existing overlapping retained/whole time fire cover to verify whether they can attend nearby volunteer areas well within 20 minutes (ie within 11 to 15 minutes).

If the higher value of life is applied, a further 9 or 10 units would be warranted in communities of 600 to 980 residents, serving a further 5848 residents.

Table 5.1: Summary of fire cover warranted for dwelling fire life risk.

Colour code	Type of cover warranted	Number of units		Population	
		Allowing for overlap between volunteers	Allowing for overlap with retained & whole time	Numbers	% of total population
Blue	Retained (at £850,000 per life saved)	1	0 (but 19 mins away)	3518	5.3
Green	Case for Change (at £850,000 per life saved)	8	5	16888	25.2
Yellow	Partly Retained Volunteer unit (at £850,000 per life saved)	21	16	24880	37.1
Sub-total		30	21 - 22	45286	68
Pink	Partly Retained Volunteer unit £850,000 to £1.25m per life	10	9	5849	9
Red	Partly Retained Volunteer unit >£1.25m per life in medium risk areas	17	15	7304	11
Mauve	Partly Retained Volunteer unit >£1.25m per life in high risk areas	33	33	8250	12
Sub-total		55	51	21810	32

Table 5.2: Ranking of Highlands and Islands units according to community size

Number of residents & type of cover	Unit name	Number of residents	RTAs and other incidents entailing extrication		Mobile (Y/N) Cutting gear	Comments
			1996/97	1997/98		
> 2800 (retained cover)	Beauly	3518	2	2	ULFA	H&I review indicates could disband if Drumnadrochit upgraded - 19 mins from Dingwall
1675 to 2800 Higher cost auxiliary cover at £850,000 per life saved	Sumburgh	2385	0	0	LFA	Island H&I review indicates could disband due to existing retained cover 6 live casualties & 1 death in 2 years - could disband due to existing cover from Lerwick H&I review indicates could disband due to existing retained cover
	St Margarets Hope	2214	0	0	LFA	
	Strathpeffer,	2194	1	1	N	
	Scalloway	2183	2	3	Y + CG	
	Balintore	2127	1	0	ULFA	
	Ness	2060	0	1	LFA	
<i>Sub-total</i>		16681	6	7		
975 to 1675 residents Lower cost auxiliary cover at £850,000 per life saved.	Cromarty	1554	0	0	N	H&I review indicates could disband due to existing retained cover 8 casualties extracted & 1 death - upgraded to retained 1998 Isolated island 5 casualties in total H&I review indicates could disband if Dunbeath is upgraded H&I review indicates could serve 1611 residents if upgraded (incl Scalpay) 6 casualties extracted & 1 death - could disband if Ft William upgraded to WT. H&I review indicates could disband due to existing retained cover H&I review indicates could cover 2009 residents (incl. Waternish, Glendale & Struan) if upgraded Island H&I review indicates could disband due to existing retained cover H&I review indicates could disband due to existing cover from Lerwick Island Island?
	Lochboisdale	1527	1	1	LFA	
	Shawbost	1479	0	0	LFA	
	Fort Augustus	1338	2	4	LFA (CG)	
	Castlebay	1316	0	0	LFA + CG	
	Bonar Bridge	1305	2	4	ULFA	
	Drumnadrochit	1253	0	2	ULFA	
	Lybster	1246	0	1	N	
	Tarbert	1229	0	0	LFA + CG	
	Spean Bridge	1203	3	1	N	
	Newtonmore	1177	0	2	N	
	Dunvegan	1177	0	0	LFA	
	Lochmaddy	1087	0	0	LFA	
	Mid Yell	1055	0	0	LFA + CG	
	Lochinver	1047	0	0	LFA	
	Portmahomack	1029	0	0	N	
	Hamnavoe	1029	0	0	N	
	Baltasound	990	0	0	LFA + CG	
	South Lochs	977	0	0	N	
	<i>Sub-total</i>		23018	8	15	
660 to 975 residents Lower cost auxiliary cover at between £1.25m and £850,000 per life saved	Helmsdale	921	0	1	LFA	Island Attended 1 in 97/98 with Scalloway H&I review indicates could disband if upgrade Walls Island H&I review indicates could serve 1484 (incl. Bixter) if upgraded H&I review indicates could disband due to existing retained cover H&I review indicates could cover 1208 residents (incl Staffin) if upgraded
	Lochcarron	871	0	1	LFA + CG	
	Hillswick	857	0	0	ULFA	
	Sandwick	848	1	0	LFA	
	Bixter	795	1	1	N	
	Leverburgh	781	0	0	LFA	
	Aultbea	765	0	1	LFA	
	Walls	689	0	0	LFA	
	Sleat	685	1	0	N	
	Nethybridge	675	0	0	N	
	Uig	654	0	0	N	
<i>Sub-total</i>		8541	3	4		

Table 5.2: Ranking of Highlands and Islands units according to community size (continued)

Number of residents & type of cover	Unit name	Number of residents	RTAs and other incidents entailing extrication		Mobile (Y/N) Cutting gear	Comments
			1996/97	1997/98		
400 to 660 residents Lower cost auxiliary cover exceeds £1.25m per life saved. (Cost per life saved in range £1.25m to £850,000 if apply High Risk rating)	Bayhead	588	0	0	N	
	Carrbridge	586	1	0	N	H&I review indicates could disband due to existing retained cover
	Boat of Garten	571	0	0	N	H&I review indicates could disband due to existing retained cover
	Acharacle	563	0	0	LFA	H&I review indicates could cover 1211 residents in Strontian & Glenborrodale
	Whalsay	558	0	0	LFA + CG	Island
	Skerries	558	0	0	LFA + CG	Island. But LFA paid & required by airport
	Staffin	554	0	0	N	H&I review indicates could disband if Uig upgraded
	Bettyhill	553	0	0	LFA	
	Cannich	552	0	0	LFA	
	Foyers	545	0	0	N	Attended 1 with Ft Augustus
	Strontian	543	0	1	LFA + CG	Upgraded to retained 1998
	John O'Groats	512	0	0	N	
	Tongue	503	0	0	LFA	
	Dunbeath	472	1	0	N	H&I review indicates could serve 1716 residents (inlc Lybster) if upgraded
	Kinlochbervie	464	1	0	LFA + CG	Upgraded to retained 1998
	Minginish	448	0	0	N	
	Kyleakin	441	0	0	N	Listed as unnecessary by H&I review to meet standards.
	Valtos	416	0	0	ULFA	
Ratagan	404	1	4	N	7 casualties in 2 years	
Glenuig	400	0	0	N		
<i>Sub-total</i>		10231	4	5		

Table 5.2: Ranking of Highlands and Islands units according to community size (continued)

Under 400 residents Cost per life saved exceeds £1.25m for lower cost auxiliary cover even if apply High Risk Rating	<i>Scalpay</i>	382	0	0	ULFA	H&I review indicates could disband if upgrade Tarbert
	<i>Westray</i>	375	0	1	LFA + CG	Island
	<i>Papa Westray</i>	375	0	0	N	Island
	<i>Durness</i>	353	0	0	ULFA	
	<i>Bressay</i>	346	0	0	N	Island
	<i>Lochaline</i>	344	0	0	ULFA	
	<i>Great Bernera</i>	337	0	0	N	
	<i>Sanday</i>	320	0	0	LFA + CG	Island
	<i>North Ronaldsay</i>	320	0	1	N	Island
	<i>Glendale</i>	309	0	0	N	H&I review indicates could disband if Dunvegan upgraded
	<i>Shapinsay</i>	307	0	0	N	Island
	<i>Rousay</i>	302	0	0	N	Island
	<i>Waternish</i>	300	0	0	N	H&I review indicates could disband if Dunvegan upgraded
	<i>Longhope</i>	300	0	0	LFA + CG	Island
	<i>Flotta</i>	300	0	0	ULFA	Island
	<i>Achiltibuie</i>	290	0	0	ULFA	
	<i>Stronsay</i>	270	0	0	LFA + CG	Island
	<i>Eday</i>	270	0	0	N	Island
	<i>Scourie</i>	250	0	0	N	
	<i>Glenelg</i>	229	0	0	N	
	<i>Struan</i>	228	0	0	N	H&I review indicates could disband if Dunvegan upgraded
	<i>Applecross</i>	222	0	0	N	
	<i>Torrison</i>	198	0	0	N	
	<i>Eriskay</i>	179	0	0	N	Island
	<i>Ardgour</i>	176	0	0	N	
	<i>Raasay</i>	168	0	0	LFA	Island
	<i>Kilchoan</i>	157	0	0	ULFA	
	<i>Kinlochewe</i>	151	0	0	ULFA	
	<i>Sheildaig</i>	146	0	0	N	
	<i>Berneray</i>	141	0	0	N	Island
<i>Strathconnon</i>	132	0	0	N		
<i>Glenborrodale</i>	105	0	0	N	H&I review indicates could disband if upgrade Acharacle	
<i>Fetlar</i>	87	0	0	N	Island	
<i>Muck</i>	75	0	0	N	Island	
<i>Eigg</i>	75	0	0	N	Island	
<i>Knoydart</i>	60	0	0	N		
<i>Achfary</i>	53	0	0	LFA		
<i>Sub-total</i>		8632	0	2		
	Total	67103	21	33		

5.2.2 Other risks

Special services

The impact of RTAs on the cost-effectiveness of the three fire cover options is first considered by determining whether the location of incidents entailing extrication of casualties has (to date) coincided with those areas for which one or another fire cover option might be classed as cost-effective on the basis of fire risk in the home.

Of the 21 incidents in 1996/97 and 33 in 1997/98:

- about 30% were attended by the 8 units which already serve over 1680 residents,
- 40 to 50% were attended by the 21 units which serve 975 to 1680 residents,
- of the remaining 10 incidents in 1997/97 Ratagan attended 4.

On the whole, there are no reported incidents attended by the 68 units serving less than 980 residents, with only Bixter and Ratagan attending incidents in both of the years 1996/97 and 1997/98. Review of early years (1994-1996) concurs with this finding.

The coincidence of RTAs and other incidents entailing extrication of casualties is illustrated on Table 5.2, where the number of such incidents is shown for the past two reported years. If it is accepted that it is justified to expend at least £50,000 per attendance (as per Ambulance Service costs per life saved in rural areas), the regular occurrence of 2 or more incidents warrants retained cover, 1 per year warrants the higher cost auxiliary option and 1 every two years just about warrants the lower cost auxiliary option (if allowance is made for other incidents). The number of RTAs and other special services involving risk to life are colour coded as follows:

- Blue (standard retained units) = 2 or more incidents per year
- Green (Case for Change units) = 1 a year
- Yellow (Partly Retained Volunteers units) = 1 every 2 years
- White = none reported in 2 years

The application of this to the Highlands and Islands units, after allowing for overlapping units and existing fire cover, leads to:

- 4 standard retained units instead of 1, (one of which is Fort Augustus, already upgraded to retained status)
- 10 Case for Change units instead of 8,

- 23 Partly Retained Volunteer units instead of 21

ie a total of up to 37 instead of 21 to 30 units warranted by dwelling fire risk alone - serving a total population of at least 50,174, 75% of the total (an additional 4,888 residents).

Other types of premises

As noted in section 1, application of the criteria regarding the risk posed by larger buildings, such as hotels, developed under the JCACR research, indicates that risk of major fires is not significant in any one of the surveyed communities - due to the relatively small number and size of such premises. These criteria indicated, for example, the risk posed by 120 high risk buildings (typically over 100 occupants, sleeping risk and 2 or 3 storeys) would require provision of a higher standard of fire cover. None of the surveyed communities had more than 40 "larger" premises, most of which had capacity for under 100 occupants. In addition, auxiliary fire units have not been "designed" to handle major fire-fighting and rescue operations without assistance. For example, their ladders will reach the second storey only. This again highlights the importance of fire safety in assuring the protection of persons in sparsely populated areas.

Notwithstanding these points, a check has been made on the coincidence of other types of premises with the size of communities, as illustrated in Table 5.3 for 3 Highlands and Islands districts. On the whole the number and size of hotels and schools etc correlate with the size of communities, with the majority of such premises located in those communities for which auxiliary or retained cover is warranted on the grounds of dwelling fire risk or RTAs.

Table 5.3: Coincidence of other premises with communities

	Unit	Number of residents	RTAs and other incidents		entailing extrication	Hotels & hostels	Schools & colleges	Care & nursing homes	Shops	Restaurants & pubs	Factory	Offices	Other	Total	Mobile (Y/N)	Comments
			1996/97	1997/98												
Over 2800 residents	Beauly	3518	2	2	3	2	1			3				9	ULFA	Could disband if Drumnadrochit upgraded
1675 - 2800	Strathpeffer,	2194	1	1	19	2	4	8		1	5	1	40	N	Could disband due to existing retained cover	
	Balintore	2127	1	0	2	2		6		1	5		16	ULFA	Could disband due to existing retained cover	
	Ness	2060	0	1	2	3		4			2	6	17	LFA		
<i>sub-total</i>			2	2	23	7	4	18	0	2	12	7	73			
975 to 1675 residents	Cromarty	1554	0	0	1	2	2	11		1	3	1	21	N	Could disband due to existing retained cover £18m 600 passenger ferry	
	Lochboisdale	1527	1	1	3	2	3	6		2	6	5	27	LFA		
	Shawbost	1479	0	0	2	4		4	1	2	4	11	28	LFA		
	Castlebay	1316	0	0	6	3	1	5		4	8	4	31	LFA + CG	Isolated island - £18m 600 passenger ferry, 1 hospital and airport H&I review indicates could serve 1611 residents if upgraded (incl Scalpay)	
	Tarbert	1229	0	0	2	4	1	4	0	5	6	5	27	LFA + CG		
	Dunvegan	1177	0	0	11	2	2		3	1		2	21	LFA	Could cover 2009 residents (incl. Waternish, Glendale & Struan) if upgraded	
<i>sub-total</i>	Lochmaddy	1087	0	0	4	1	2	4		1	10	3	25	LFA	Could disband due to existing retained cover Island	
	Portmahomack	1029	0	0	3	1		3				1	8	N		
	South Lochs	977	0	0	1	1	0	0	0	1	1	0	4	N		
			1	1	33	20	11	37	4	17	38	32	192			
660 to 975 persons	Lochcarron	871	0	1	4	1		6		4	3		18	LFA	LFA + CG	
	Aultbea	765	0	1	13	5	1	5	0	1	2	0	27			
	Leverburgh	781	0	0	1	1	1	5	1	1		5	15	LFA	Island	
	Sleat	685	1	0	7	2	0	0	2	0	0	1	12	N	Could cover 1208 residents (incl Staffin) if upgraded. 2 ships (100 and 600 persons)	
	Uig	654	0	0	7	1	1	0	3	0	0	3	15	N		
<i>sub-total</i>			1	2	32	10	3	16	6	6	5	9	87			

Table 5.3 (cont.): Coincidence of other premises with communities

	Unit	Number of residents	Number of other premises										Mobile (Y/N)	Comments	
			RTAs and other incidents	entailing extrication	Hotels & hostels	Schools & colleges	Care & nursing homes	Shops	Restaurants & pubs	Factory	Offices	Other			Total
														Cutting gear	
Under 660 residents	Bayhead	588	0	0	0	1	3	1				3	8	N	RAF North Uist
	Staffin	554	0	0	7	1	1	0	1	0	0	2	12	N	Disband - see Uig
	Minginish	448	0	0	6	1	0	0	1	1	0	1	10	N	
	Kyleakin	441	0	0	11	1	0	0	1	0	0	1	14	N	Listed as unnecessary to meet standards.
	Valtos	416	0	0	0	1					1	7	9	ULFA	RAF Aird Uig
	Ratagan	404	1	4	1	1	0	0	2	0	0	2	6	N	7 casualties in 2 years
<i>sub-total</i>			1	4	25	6	1	3	6	1	1	16	59		
Under 400 residents	Scalpay	382	0	0	0	1	1	1	1			4	7	ULFA	H&I review indicates could disband if upgrade Tarbert
	Great Bernera	337	0	0	0	1	0	2	0	1	0	2	6	N	
	Glendale	309	0	0	0	1	0	0	2	0	0	0	3	N	Could disband if Dunvegan upgraded
	Waternish	300	0	0	1	1	0	0	1	0	0	1	4	N	Could disband if Dunvegan upgraded
	Glenelg	229	0	0	2	1	0	0	2	0	0	1	6	N	
	Struan	228	0	0	1	1	1	0	1	0	0	0	4	N	Could disband if Dunvegan upgraded
	Applecross	222	0	0	3	1	0	0	0	0	2	0	6	N	
	Torrison	198	0	0	4	1	0	1	0	0	2	0	8	N	
	Eriskay	179	0	0	1	1	0	1	0	0	0	1	4	N	Island
	Raasay	168	0	0	4	1	0	0	0	0	0	0	5	LFA	Island
	Kinlochewe	151	0	0	7	2	0	2	0	0	0	0	11	ULFA	Caravan park
	Sheildaig	146	0	0	3	1	0	1	0	0	0	0	5	N	
	Berneray	141	0	0	1	1	0	2	0	0	0	0	4	N	Island
Strathconnon	132	0	0	2	1	1	1	0	0	0	0	5	N		
<i>Sub-total</i>			0	0	29	15	2	11	6	2	4	9	78		
	Total		7	11	145	60	22	85	22	31	60	73	498		

5.3 Mull

5.3.1 Dwelling fire risk

The cost per life saved has been estimated for a high risk category as well as a medium risk category for Mull, as a sensitivity analysis. In neither case does the population level match the guideline for the Case for Change option, even if the higher value of life of £1.25m is applied. With a population of 1,893 outside of Tobermory (excluding Iona), the cost per life saved for 3 Case for Change units with a 11 to 15 minutes response time at £60,000 per year each (i.e. a total cost of £180,000 p.a.) would be as follows:

- £1.37m, assuming a high risk rating
- £2.26m assuming a medium risk rating.

Each village has been examined separately, assuming that the population of 757 outside of the villages is evenly split between the three villages, and again assuming a 11-15 minutes average response time and a £35,000 to £60,000 per unit. The estimated cost per life saved is given in Table 5.4. The risk experienced by Craignure, Iona and Bunessan does not warrant the lower cost Partly Retained Volunteer fire cover option at either £850,000 or £1,250,000 per life saved if the medium risk rating is applied. Only Salen is warranted if the higher value of life of £1.25m is applied. The population levels at Salen and Craignure would warrant a Partly Retained Volunteer unit if a high risk rating is assumed, with Bunessan coming close to satisfying the cost-effectiveness guideline.

It would be necessary to reduce the annual cost of the Iona unit to £9,500 for the cost per averted dwelling fire death to fall below £850,000. Reference back to table 2.4 indicates that (assuming a medium risk rating) fire cover (capable of undertaking rescues) would be warranted for each of Salen, Craignure and Bunessan if the cost was in range £20,000 to £30,000 per year for each unit, ie about £70,000 for the 3 units in total.

**Table 5.4: Estimated cost per life saved by fire cover on Mull
(at £35,000 and £60,000 per unit per annum)**

Area	No of residents	£35,000 per unit		£60,000 per unit	
		Medium	High	Medium	High
Salen	762	£1.09m	£0.663m	£1.87m	£1.4m
Craignure	590	£1.4m	£0.856m	£2.42m	£1.47m
Bunessan	540	£1.54m	£0.935m	£2.65m	£1.6m
Iona	160	£5.2m	£3.16m	£8.93m	£5.41m

5.3.2 Other risks

The risk to life posed by other types of incidents on Mull is low, with just 1 reported RTA involving extrication of casualties every 5 years. However, it could be argued that this does support the case for a unit at Salen whose population level is already within about 10% of the suggested guideline for medium risk areas.

As regards other types of premises, there are about 30 larger premises, mostly hotels commercial and historical buildings outside of Tobermory (excluding farms), three of which are on Iona - including Iona Abbey. As with the Highlands and Islands, the risk posed by these premises does not require a higher level of fire cover in their own right, again highlighting the importance of assuring appropriate fire safety standards are maintained in these areas.

5.4 Other fire cover options?

Discussions with the Highlands and Islands Fire Brigade and the Scottish Office highlighted three other possible options for reducing risk to life from fire in the home. The acceptability and practicality of these options have yet to be confirmed and therefore they have not been subjected to more detailed scrutiny. However, they may be worth exploring further in the event that currently upgrade options are not taken forward.

Non-mobile units with CABA and pagers

The possibility of supplying (say) 6 volunteers per unit with CABA and all 10 with pagers has been raised, particularly in the context of smaller communities. This option is raised partly on the grounds that volunteers will attempt a rescue with or without CABA. Therefore, the provision of CABA is an absolute minimum requirement. Whilst the cost of this option has not been formally assessed, it is likely to be less than £10,000 per annum per unit if the costs for appliances, fire stations and retaining fees are not incurred - which is warranted for medium risk communities of 300 or more.

Domestic sprinklers

With a capital cost of £266,000 for an auxiliary unit, the capital costs of installing domestic sprinklers at about £2,000 per house would be less than the capital costs of "auxiliary" grade fire cover for communities of 133 houses (ie about 300 residents). Moreover, if revenue costs are taken into account the capital cost of installing domestic sprinklers (again assuming £2000 per house) into communities of up to 1000 residents (about 450 houses) would equate to 15 years total operating costs (£900,000 in 1998 prices) of an auxiliary unit. Thus, it would be no more costly to install domestic sprinklers than to have auxiliary fire cover in the smaller communities. American experience with domestic sprinklers indicates that they avert over 50% of fire deaths in the home, compared with under 40% predicted here for fire cover. Thus, domestic sprinklers are likely to be a more effective and cheaper option than fire cover for smaller communities, providing that water supplies and mains pressure are suitable.

However, the practicality of this option is unclear as new primary legislation may well be required to empower authorities to install or require the installation of sprinklers into homes. Also, it would be necessary to check whether water pressure in rural areas is adequate for domestic sprinkler systems.

Partnering

As part of this study consideration has been given to the possibility of sharing facilities and personnel with other emergency services, and the impact that this may have on the cost of fire cover. Highlands and Islands and Strathclyde fire brigades identified the location of other emergency services in the study areas, and reviewed the feasibility of sharing resources. The main findings are summarised in Table 5.5 below.

It would appear that there are a number of options worth exploring. Firstly, it is possible that the Scottish Ambulance Service may wish to share facilities in those areas where they are planning a new unit. However, as the capital plans of fire and ambulance services are not currently co-ordinated, this would necessitate co-ordination of capital before it is likely to have an impact at a local level. In addition, information is not available on the impact of sharing facilities on fire service costs, as a fire station designed for a single appliance may need to be expanded to accommodate an ambulance. In the case of Mull, the SAS have no plans to build any premises, leaving 3 existing vehicles parked outside of drivers houses.

Secondly, there is an extensive network of BASICS (doctors) who can be called on for attendance at RTAs and house fires to attend casualties, thereby probably avoiding the need for upgrading trauma skills of volunteers beyond first aid level.

The opportunities for sharing resources with airports have apparently already been taken. It should be noted that in the absence of volunteer units at Foula and Skerries the airports would have to recruit a replacement fire team. In case of Mull, it is possible that the coast guard will want to build at Salen, which happens to be the one village on Mull lacking a fire station, although there are no immediate Coast Guard plans for this. Again, the capital plans of the brigade and the coast guard would need to be co-ordinated.

Discussions regarding the possibility of sharing ambulance personnel indicates that operational arrangements would need to be evaluated first. In particular, it would be necessary to establish whether there is a potential for role conflict of staff at incidents, such as RTAs, where there was a need to attend a casualty and manage the fire risk. Notwithstanding this concern, it is noted that:

- personnel at a number of US fire departments also serve as ambulance paramedics services,
- fire-fighters (Sapeurs Pompiers) in the French joint fire-ambulance service have several types of vehicles, including fire and rescue tenders, chemical and maritime accident vehicles, and emergency road ambulances. They have the capability of sending ambulance drivers in a general purpose vehicle or, in some areas, to send medical teams in ambulances. In France doctors have responsibility for medical incidents but some Sapeurs Pompiers are trained to assist doctors. The service employs a bank of doctors, usually GPs, who are paid to be on standby and have

undergone specialist medical training, and are capable of assisting Sapeurs Pompiers when they are dealing with trapped casualties etc as well attending medical emergencies.

- although individual personnel in German joint fire-ambulance services can switch (after training) from fire to ambulance duties, they perform one or another role at a time - with separate fire and ambulance staff at each station.
- in Hong Kong, whilst the Ambulance Command is part of the Fire Services Department, staff do not have dual roles.
- Warwickshire fire crews act as “first responders” on behalf of the ambulance service in parts of Warwickshire

Thus, there are varying degrees of role sharing amongst fire and ambulance staff in other countries.

As regards other partnering opportunities:

- No forestry fire teams were identified,
- the mobilisation times of helicopters means they are not a viable first response to house fires, and;
- partnering with police, mountain rescue, airport fire services and industrial fire teams is of little apparent value due to restrictions on the availability of personnel and/or long mobilisation times.

Partnerships with airport is only practical where the number of flights does not demand full time fire cover - in which case fire units only need to stand by during the occasional schedule flight and can provide fire cover to residential areas at other times.

Table 5.5: Summary of Highlands and Islands partnering opportunities discussion.

Organisation	Comments
Mountain rescue	Each of the 9 mountain rescue units in Northern Constabulary area of Scotland cover a mountain range, such as the Torridon range. Volunteers may live anywhere across that range. Accordingly their mobilisation time is up to 1 hour. Also, many volunteers are police officers who cannot act as retained fire fighters.
Police	Police officers are not allowed to act as retained fire fighters
Airport fire service personnel	Airport fire fighters are currently not allowed to act as retained fire fighters, even when off-duty, by airports - due to the need to assure fitness of staff on return to airport duty. Also, personnel may not live locally, and may live in main villages etc covered by existing retained services. Airport fire services must remain onsite during operational hours to allow airport to remain open. Also, none of the airport fire services in Highlands and Islands (Dalcross, Wick, Sumburgh, Kirkwall, & Stornaway) possess domestic fire appliances, i.e. just have foam capability. Only Sumburgh is in an area served by volunteers, all others are in areas served by retained or whole-time. However, Foula and Skerries pay for provision of Light Fire Appliance and allow its use off site, as these airports only have 2 to 4 flights a day. Appliances standby during flights.
RNLI	There are no restrictions on sharing personnel, but as they are unpaid there is currently no opportunity to share retaining fees. Most lifeboat stations are already constructed, offering few known opportunities to share facilities.
Air sea rescue	Air sea rescue (Prestwick, Stornaway, Lossiemouth, Bullmore and Sumburgh) will provide free transport to life risk incidents unless a marine incident is in progress to which they would award priority. A charge is made for attendance at non-life risk incidents. A mobilisation time of 25 mins in the day and 45 minutes at night (except 24 hour RAF cover), limits role of helicopters as first attendance at dwelling fires. However, they can transport 12 personnel and equipment to remote/isolated areas to help with prolonged fires.
Industrial fire teams	The 4 industrial fire teams in the Highlands and Islands are in areas served by retained or whole time fire stations, namely; Flotta, Dounreay, Sullom Voe and Norbord (Inverness). Sites have been reducing the size of fire teams subsequent to upgrading of fixed fire fighting systems, with reliance placed on local fire brigade for additional fire fighting resources. These teams must remain on-site for insurance reasons.
Air ambulance (Inverness)	Only accommodates pilot, doctor and casualty. Only flies day light hours, 7 hours in winter.
Scottish Ambulance Service	The SAS reportedly do not view provision of ambulance stations in areas with unsheltered ambulances a priority. However, as SAS have only 34 units in the whole of Highlands and Islands (only 3 units in Orkneys and 4 on Shetlands) it is possible that they may be interested in sharing new facilities if they have expansion plans.
BASICS	There are numerous BASICS doctors in Scotland, including 33 out of 35 GPs on Western Isles. It is possible that they would act as medical staff (in place of paramedics/technicians) on fire crews - for attendance at RTAs etc. Probable that these GPs are located in all areas served by volunteers.

Retaining existing volunteer units

In the absence of a volunteer unit the call would need to be answered by the next nearest unit, either retained or whole time. In the event that a whole time unit attends, a retained unit would be placed on standby to maintain cover at the whole time station. Thus, the cost of attending a call in the volunteer area would be a minimum of £110, i.e. the first hour turnout fees for a retained unit.

Thus, disbandment of volunteer units attending (say) 50 calls per year in areas served by retained or whole time units would entail retained unit turn-out costs of about £6,000 per year. Therefore, a volunteer unit whose annual costs for attending a given number of calls are less than the call-out cost of retained units for the same number of calls would be the lower cost option. Given that the cost of a volunteer unit supplied with CABA would exceed this level, such a unit could not be equipped with CABA or LFA and hence would only be able to attend incidents which do not demand CABA or a light/midi fire appliance - with other calls attended first by LFAs, midi appliances or retained appliances. Thus, this option could only be pursued where the next nearest retained, auxiliary unit (with LFA or midi-appliance) or whole time unit could attend the area within the required response time for dwelling fires, RTAs involving casualties etc.

This raises the option of maintaining lower cost volunteer units to attend small incidents in areas served by retained units, whole time units or auxiliary units, with incidents requiring use of CABA attended by retained, auxiliary or whole time units. Thus, for example, the volunteer unit at Strathpeffer attended 40 calls in 1995-96. This area can be attended within 15 minutes by the Dingwall retained unit. However, assuming that (say) 35 of the calls did not require CABA or other specialist gear, the Strathpeffer unit would be economic so long as it did not cost more than about £3,500 per year to maintain. Similarly, the 4 units in the Badenoch and Strathspey district which are sited within 20 minutes of retained units, whom attended 88 calls in 1995-96, would remain the cheaper option so long as their annual cost falls below £9600.

The feasibility of this option would need to be explored further, such as whether it is possible to delineate a range of low risk incidents (e.g. chimney fires) that such units could attend without support from a retained/auxiliary unit at no risk to either themselves or others.

5.5 Community fire safety

5.5.1 Overview

The current provision of community fire safety services has been briefly reviewed due to the importance of these services in reducing fire deaths in sparsely populated areas and to judge the scope for improvement. In short, there is significant scope for increasing the level of community fire safety work in both the Highlands and Islands and Strathclyde areas. Volunteer fire fighters could play an important role in the implementation of such services.

5.5.2 Current community fire safety arrangements

A description of current arrangements is given below for the two brigades. In neither case do volunteers play a significant role in local community fire safety.

Highlands and Islands Fire Brigade

Discussions with Highlands and Islands Fire Brigade indicates that community fire safety work is restricted to ad hoc actions after high profile fires and participation in Inverness based initiatives such as Safe Highlander and leafleting by meals on wheels within Inverness. There is no schools based programme other than occasional schools quizzes, and little liaison with housing authorities or social services.

The brigade currently has 3 officers at HQ level and 1 or 2 officers per district responsible for statutory fire safety responsibilities. There are no officers dedicated to community fire safety work, even on a part-time basis.

Strathclyde Fire Brigade

The Strathclyde fire brigade has an extensive range of community fire safety initiatives, as outlined below:

- participation in Safe Strathclyde
- liaison with social services, who target vulnerable persons via Home Helps,
- ongoing schools programme (primary 5 and 6) delivered by fire officers annually to all schools in the region. This includes national and general themes as well as themes linked to time of the year (e.g. Guy Fawks).
- liaison with district housing authorities regarding provision of smoke detectors in let housing.
- ad hoc initiatives after significant fires, particularly fatal fires.

These initiatives are supported by 12 community fire fighters, each of whom serves a part of Strathclyde, a central Community Fire Safety Unit and one Community Fire Safety Unit per command.

However, discussions indicate that these initiatives are unlikely to be equally effective in rural areas for a number of reasons:

1. Some initiatives are restricted to the urban areas, such as Safe Strathclyde,
2. The provision of social services, via which the brigade operates, is less frequent in rural areas.
3. It is judged that rural communities are less receptive to advice from third parties.
4. Many charities do not operate in rural areas, such as Age Concern.

5. It is more difficult to sustain community initiatives in areas reliant on retained fire stations, especially isolated islands and communities.

Thus, it is possible that, aside from simply extending community fire safety initiatives into remote areas, current community fire safety programmes would need to be modified to better match the circumstances and special needs of local communities in remote areas. This could include identifying new organisations to liaise with, such as churches, in those areas where social services/charities do not operate so extensively.

5.5.3 Extending community fire safety

Discussion with the two brigades indicates that a higher level of community fire safety work could be achieved in remote areas by:

1. Better resourcing “central” community fire safety units, such as appointing more community fire fighters in Strathclyde and creating a community fire safety unit in Highlands and Islands. The latter unit could develop programmes and travel around all districts utilising local facilities such as village halls.
2. Involving volunteer fire fighters in implementation of “basic” community fire safety work, such as schools programmes, talks to youth groups, door-to-door visits to vulnerable persons to advise on fire detectors and fire escape plans etc.
3. Setting up liaison with other organisations operating in remote areas, such as churches as well as home helps etc.
4. Implementing a schools based programme in Highlands and Islands.

The involvement of volunteer fire fighters would require appropriate training and payment, but there are no concerns about their ability or willingness to undertake such work, other than any restrictions posed by work commitments.

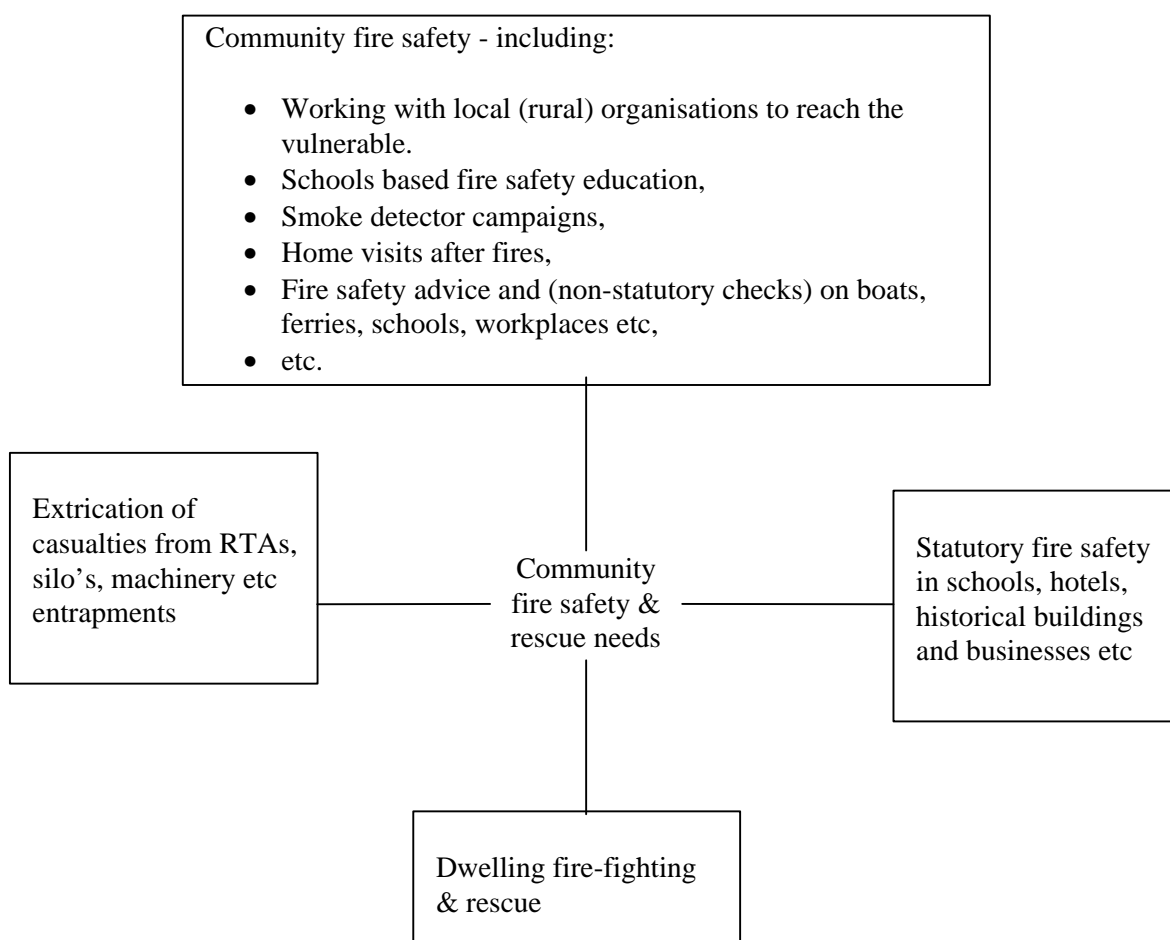
6. CONCLUSIONS

Fire cover risk assessment in remote rural areas.

We have been able to establish a method for determining fire cover in remote rural areas based on risk assessment which fits in with the work completed for the JCACR. This method has been successfully applied to a sample of areas currently served by volunteer fire units.

The types of risks and fire service requirements in sparsely populated areas identified by this study are illustrated in Figure 6.1. The results indicate that any review of fire services in sparsely populated areas should aim to fulfil these requirements, with the capabilities of local fire services matched to the profile of risks in the local area. Thus, for example, extrication of casualties from RTAs is a key requirement in the larger Highlands and Islands communities, but is a relatively infrequent occurrence in the sparsely populated parts of Mull. The significance of local fire and non-fire risks can be assessed against the guidelines applied here, with the type and make-up of fire cover matched to the type and level of risks identified.

Figure 6.1: Fire safety and rescue requirements in sparsely populated areas



Risk to life in remote rural areas.

The risk to life from fire in the home is high in those sparsely populated areas reviewed in this report, despite the low population density.

The risk needs to be significantly reduced for it to reach those levels considered tolerable within the JCACR work.

Reducing risk

Fire cover alone, within practical cost, is insufficient to reduce the fatality rate to as low as reasonable practicable. The prevention of fires and improvement of fire safety in the home is required to achieve this goal.

Community fire safety opportunities

There is great scope for improving community fire safety services in sparsely populated areas, both by extending existing initiatives into rural communities and tailoring initiatives to the needs and circumstances of rural communities. Volunteer fire fighters could play a role in the implementation of these initiatives, providing an important local resource for what are often geographically isolated areas.

The achievement of high standards of fire safety is also important in other types of buildings, such as hotels historical buildings and schools, in sparsely populated areas. On the one hand, the small number of these buildings in any one community does not warrant a higher level of fire cover in their own right. On the other hand, the proposed "auxiliary" grade of volunteer fire cover are not equipped (either in hardware or by training) to handle large fire and rescue operations unaided. Thus, the safety of occupants in these buildings will continue to depend on the maintenance of fire safety precautions.

Thus, it is essential and would appear to be practicable to achieve a higher standard of community fire safety in remote rural areas.

Road Traffic Accidents

There is also a need to provide fire cover to extricate casualties from road traffic accidents. Volunteer units in the Highlands and Islands extricate many more casualties from RTAs than dwelling fires, highlighting the importance of this service. These incidents occur mainly in the relatively larger communities which present the greatest risk of fires in the home by virtue of their larger populations.

When is retained or partly retained fire cover warranted?

Notwithstanding the above, fire cover does play a role in minimising loss of life from fire in sparsely populated areas. The analysis suggests that the cost of providing one or another of the three fire cover options is warranted in the relatively larger communities, including standard retained units in the case of a few of the largest rural communities.

Thus, whilst improving community fire safety probably offers the most effective means of reducing loss of life fire in the home at the least cost, the provision of fire cover capable of handling RTAs and dwelling fires is warranted in the relatively larger communities.

Fire Cover in smaller communities

There is a need to seek alternative fire cover arrangements for the smaller communities. Some options which deserve further examination include:

1. improving the capability of non-mobile units in smaller communities,
2. the use of domestic sprinklers,
3. partnering with other emergency services, especially the Scottish Ambulance Service.

The practicality, cost and effectiveness of these options need to be examined further before they can be fully evaluated.

7. REFERENCES AND PERSONS CONSULTED

7.1 References and information received

7.1.1 References

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7.1.2 Information received

The following information was received from Highlands and Islands and Strathclyde fire brigades:

- Copies of FDR1s for all fatal fires in Highlands and Islands, 1992-1996,
- Copies of FDR1s for all fatal fires on Mull, 1987-1996,
- Number of dwelling fires in each surveyed community served by volunteer units in 1992-1996,

- Number of fire casualties, deaths and rescues in each surveyed community served by volunteer units in 1992-1996,
- Number of residents in each surveyed community,
- number of RTAs and other non-fire special services involving extrication of casualties in each community in 1996-1997, and 1987-1996 on Mull,
- list of non-residential premises in 3 Highlands and Islands districts and Mull, with number of floors and type of premise indicated,
- type of appliances and station construction for each unit,
- sample of costs of construction of stations for 9 Strathclyde auxiliary fire stations,
- location of all ambulance, General Practitioners, mountain rescue, industrial fire teams, airport fire services, coast guard and RNLI stations in surveyed areas,
- overview of community fire safety initiatives in surveyed areas.

7.2 Persons consulted

Discussions have been held with the following individuals:

Firemaster Robert Gordon QFSM AIFireE, Highlands and Islands Fire Brigade

Assistant FireMaster Jack Stewart, Strathclyde fire brigade

Station Officer John Spence, Strathclyde Fire Brigade

Divisional Officer U. MacLennan, Highlands and Islands Fire Brigade

John Harwood, Home Office, Fire Research and Development Group

Marion Gunn, Scottish Office Fire Services and Emergency Planning Division

HMCIFS Neil Morrison CBE QFSM Dtech FIFireE.

APPENDIX A

COST OF FIRE COVER OPTIONS

A.1 OVERVIEW

Three possible upgrades have been assessed in detail, namely:

1. Upgrading volunteer units to retained status,
2. Upgrading volunteer units to the standard proposed in the “Case for change”, based on Highlands and Islands “Cost of Compliance” report,
3. Upgrading volunteer units to the higher standard currently achieved at some volunteer units, comprising Light Fire Appliances, CABA, and pagers.

As discussed below and illustrated in Table A.1, the annual unit cost (including annualised capital costs) is estimated to vary from about £35,000 for the third option, to about £53,000 to £64,000 for the second option, and about £102,000 for retained units, in 1998 prices. The actual cost of each option will vary according to local construction and operational factors. For the purposes of this study the values of £100,000, £60,000 and £35,000 are used for Standard Retained units, Case for Change units and Partly Retained Volunteer units. It should be noted that the Case for Change and Highlands and Islands associated “Cost of Compliance” report related to an ideal standard. The lower cost Partly Retained Volunteer Unit option is based on facilities currently supplied to a number of CABA equipped mobile (LFA) units, with additional cost of retaining fees for two officers per unit and training.

Upgrading the remaining 137 volunteer units in the Highlands and Islands to the new standard would cost about £7.5m to £9m per year, taking the higher annual unit cost of £54,000 to £64,000 each. The total annual cost of providing the lower cost Partly Retained Volunteer unit option (a garage with a Light Fire Appliance for a unit with fewer turnouts, fewer volunteers on retainer etc) would be about £5m per year.

Cost of Highland and Islands fire brigade proposals

The projected capital costs of the upgrades to retained and “auxiliary” status for Highlands and Islands, as noted in its fire cover review, are £11m for 21 retained units (at about £400,000 per station plus £110,000 per appliance), £8.5m for 53 auxiliary fire stations (at up to £266,000 per station, but less where existing facilities can be modified), and £1.8m for 3 new Hot Fire Training facilities, i.e. a total capital spend of up to £21.3m. If revenue costs of £37,720 per auxiliary unit and £46,700 per retained unit are applied the annual revenue costs for Highlands and Islands are estimated at about £1,000,000 for 21 retained units and £2m for 53 auxiliary units, plus an increase in support costs of at least £0.25m. The revenue cost for upgrading 95 volunteer units to auxiliary standard would be about £3.8m, inclusive of support costs.

Table A.1: Annualised costs of volunteer and retained fire units

Station type	Annual capital & loan costs			Annual revenue		Total annualised costs
	Station	Vehicle	Hot Fire House	Station costs	Central support	
Retained	£33,200	£15,277	£3430	£47600	£2400	£101,907
Case for Change - with higher construction cost	£16,000	£7,600	£935	£37720	£1600	£63,855
Case for Change - with lower construction cost	£5,600	£7,600	£935	£37720	£1600	£53,455
Partly Retained Volunteer Unit	£4,000	£4,160	£935	£25000	£1600	£35,695

A.2 Elaboration of costing

An interest rate of 8% has been applied to annual loan costs for capital items, allowing a 25 year period for premises and 12 years for vehicles. Modification of the interest rate by 2% does not significantly affect the total annual cost, giving a variance of a few thousand pounds. Inflation has been ignored for both the cost of units and the subsequent valuation of averted deaths. The capital cost of Hot Fire Training facilities and central operating costs have been split 50:50 between those retained stations and auxiliary units proposed by Highlands and Islands fire brigade. It should be noted that information received from the Scottish Office suggests that adequate Hot Fire Training facilities can be provided at a lower cost than envisaged by the Highlands and Islands fire brigade. However, the cost of Hot Fire Training is a relatively minor item which is cancelled out within the rounding up of the total annual cost. Therefore, the cost of Hot Fire Training is not examined further here. Minor costs items, including pagers and uniforms have been ignored.

Standard Retained fire units

The cost of retained fire units are all based on Highlands and Islands information as follows:

- £110,000 capital cost per appliance,
- ~£400,000 capital cost per station,
- £47,600 revenue costs per unit.

Case for Change units

The higher estimated cost of meeting the standard laid out in “A Case for Change” is based on the costs given by Highlands and Islands fire brigade in its “Cost of Compliance” report, plus loan charges for capital items. The Highlands and Islands Fire Brigade estimated the capital cost of the upgrades at £266,000 with annual revenue costs of £37,720 per unit as shown in Table A.2, annualised at about £57,420 per year per unit. The addition of central costs and hot fire training costs raises this to somewhat over £60,000 per year.

Table A.2: Projected capital and revenue costs for auxiliary units (Highlands and Islands Fire Brigade)

Subject	Capital	Revenue
Change of name	-	-
Medicals	-	£110
Premises	£200,000	£7,000
Vehicles	£55,000	£1,500
Uniform	£3,200	£640
Communications	£8,250	£570
Training	-	£14,000
Retaining and turnout fee	-	£13,900
	£266,450	£37,720

However, the actual cost of constructing the proposed standard of premises varies according to local factors, such as land price factors and transport costs. Discussions indicate the actual construction cost has ranged from £100,000 to £200,000. The application of a lower construction cost reduces the total annual cost to about £53,000. Therefore, the cost of meeting the standard laid out in “A Case for Change” is in the region of £53,000 to £64,000. A value of £60,000 is used for the purposes of this study.

Partly Retained Volunteer Units

Discussions with Highlands and Islands and Strathclyde fire brigade indicates that those units with recently built “garages” (which include toilet facilities) have sufficient room for a LFA, CABA storage and pagers, and could be sufficient for lectures (if the appliance is parked outside). Discussions with Highlands and Islands and Strathclyde fire brigade indicates that the upgrade of these units is not a priority concern. Whilst many of these garages would require modification to accommodate the proposed longer wheel base LFA, those units already supplied with short wheel based Light Fire Appliances are not a priority concern.

Also, discussions with Highlands and Islands Fire Brigade indicates that the revenue costs projected to date relate to the “ideal” standard. There are at least three reasons why the revenue cost of the proposed standard may differ from the projected cost:

1. Whilst the ideal standard entails training and equipping all 10 members of volunteer units with CABA, the minimum which would be accepted is 6. This would reduce equipment and training costs.
2. The payment scheme for volunteers has yet to be decided. Options include:
 - paying retaining fees to all 10 members of each unit,
 - paying retainers to 2 members (the unit leader and deputy), with others paid turnout fees only - as per the current Strathclyde arrangement,
 - paying a reduced retainer to volunteers, and,
 - paying an enhanced retaining fee but reduced turnout fee.
3. The number of turnouts per year will vary between units, from less than 10 for some to up to 100 for others. Thus, the turn out costs may vary from under £1,000 to about £10,000 per unit.

The construction of a garage (with room for CABA, toilet and uniforms) suitable for a LFA costs about £70,000, based on discussion with Highlands and Islands fire brigade, whilst the cost of a LFA (based on the adapted transit van currently in use) is about £30,000 to £40,000, again according to discussions with the Highlands and Islands fire brigade.

The revenue cost per unit is estimated at about £25,000 per year where:

- about £800 for attending about 7 calls per year,
- somewhat below £14,000 for training 10 officers,
- £1,500 for maintenance of vehicles and equipment,
- £7,000 for heating, maintenance etc of premises
- £2,500 for paying retainers to 2 volunteers.
- £640 for replacement of 2 uniforms per year
- £570 ongoing communications maintenance

This eliminates the cost of retaining fees for 8 personnel (about £10,000 in total per annum) and reduces turnouts costs by about £600 per year, compared with the costs laid out in the Highlands and Islands “Cost of Compliance” report. The training cost would be reduced by training 6 instead of 10 officers in the use of CABA. However, the exact cost is not estimated here. Instead the revenue cost is rounded down to give a total cost of £25,000, allowing for about £2,000 saving on training costs.

Thus, allowing for central support, hot fire training facilities and capital costs and loan charges on premises/vehicles and the cost of introducing communications and other new

equipment, a LFA unit would cost up to about £35,000 per annum - ~£25,000 revenue costs and £8,000 capital/loan costs and £2,000 support/training facilities costs.

APPENDIX B

**RATES OF FIRE AND CASUALTY IN VOLUNTEER
AREAS.**

Highlands and Islands

Table B.1 provides a summary of the rates of fire and casualty in the Highlands and Islands. The base data for individual units is shown in Table B.2. The analysis was completed for the 4 year period 1994/95, 1995/96, 1996/97 and 1997/98.

Table B.1: Number and rates of fire and casualty for period 1994-1998

District	Total population	Dwelling fires		Dwelling fire casualties, deaths and rescues		Dwelling fire deaths	
		4 yr total	Annual rate per n persons	4 yr total	Annual rate per n persons	No 4 yr total	Annual rate per n persons
Ross & Cromarty	9679	31	1249	4	9679	1	38716
Skye and Lochalsh	5597	16	1399	1	22388	0	0
Inverness & Nairn	7206	36	801	2	14412	0	0
Badenoch & Strathspey	3009	14	860	0	0	0	0
Lochaber	3701	29	510	4	3701	2	7402
Caithness	2783	14	795	4	2783	2	5566
Sutherland	4896	35	560	4	4896	0	0
Western Isles	12499	46	1087	9	5555	1	49996
Orkney	5353	11	1947	0	0	0	0
Shetlands	12380	33	1501	4	12380	1	49520
All	67103	256	1048	32	8389	7	38345

Appendix B : Rates of fire and casualty in Highlands and Islands Volunteer Areas, 1994-1997

District	Village/unit	Number of residents	Dwelling fires per village				Total for 4 years	Annual rate of fires per n residents (1 fire per n residents p.a)	Dwelling fire casualties, deaths & rescues				Total for 4 years	Annual rate of casualty per n residents (1 casualty per n residents p.a)
			Year						Year					
			1994/95	1995/96	1996/97	1997/98			1994/95	1995/96	1996/97	1997/98		
Ross & Cromarty	Torricon	198				1	1	792					0	
	Balintore	2127	3	4	3	2	12	709			1		1	
	Cromarty,	1554		1	2	1	4	1554		1			1	
	Portmahomack	1029					0	#DIV/0!					0	
	Strathpeffer	2194	1	2		4	7	1254				2	2	
	Strathconnon	132					0	#DIV/0!					0	
	Kinlochewe	151					0	#DIV/0!					0	
	Achiltibuie	290	1	1		1	3	387				0	0	
	Applecross	222					0	#DIV/0!					0	
	Aultbea	765	1		1	1	3	1020					0	
	Lochcarron	871			1		1	3484					0	
	Sheildaig	146				0	0	#DIV/0!					0	
		sub-total	9679	6	8	7	10	31	1249	0	1	1	2	4
Western Isles	Bayhead	588		2	1		3	784		1	1		2	
	Berneray	141					0	#DIV/0!					0	
	Castlebay	1316		1	4	4	9	585	3				3	
	Eriskay	179					0	#DIV/0!					0	
	Leverburgh	781					0	#DIV/0!					0	
	Lochboisdale	1527	2	3	2	2	9	679	1	1			2	
	Lochmaddy	1087				1	1	4348					0	
	Ness	2060	1	1	1	1	4	2060	1		1		2	
	Scalpay	382					0	#DIV/0!					0	
	Shawbost	1479	2	1	5	1	9	657					0	
	Tarbert	1229			5	1	6	819					0	
	Valtos	416	1		1		2	832					0	
	Great Bernera	337					0	#DIV/0!					0	
	South Lochs	977		2	1		3	1303					0	
	sub-total	12499	6	10	20	10	46	1087	5	2	2	0	9	5555
Skye and Lochalsh	Glenelg	229					0	#DIV/0!					0	
	Dunvegan	1177	1	1		1	3	1569					0	
	Kyleakin	441					0	#DIV/0!					0	
	Raasay	168					0	#DIV/0!					0	
	Ratagan	404	2				2	808	1				1	
	Uig	654	1		1		2	1308					0	
	Glendale	309	1			1	2	618					0	
	Waternish	300					0	#DIV/0!					0	
	Staffin	554		2	1		3	739					0	
	Struan	228		1			1	912					0	
	Sleat	685			1	1	2	1370					0	
	Minginish	448		1			1	1792					0	
		sub-total	5597	5	5	3	3	16	1399	1	0	0	0	1
Inverness and Nairn	Foyers	545		1	1		2	1090		1			1	
	Drumnadrochit	1253	2	2		1	5	1002					0	
	Cannich	552					0	#DIV/0!					0	
	Fort Augustus	1338	1		3	1	5	1070					0	
	Beauly	3518	11	2	6	5	24	586				1	1	
		subtotal	7206	14	5	10	7	36	801	0	1	0	1	2

Appendix B : Rates of fire and casualty in Highlands and Islands Volunteer Areas, 1994-1997

District	Village/unit	Number of residents	Dwelling fires per village				Total for 4 years	Annual rate of fires per n residents (1 fire per n residents p.a)	Dwelling fire casualties, deaths & rescues				Total for 4 years	Annual rate of casualty per n Residents (1 casualty per n residents p.a)	Fatalities	Annual rate per n residents (1 fatality per n residents p.a)
			Year 1994/95	1995/96	1996/97	1997/98			Year 1994/95	1995/96	1996/97	1997/98				
Badenoch and Strathspey	Carrbridge	586	1				1	2344					0	#DIV/0!		
	Nethybridge	675		3			3	900					0			
	Boat of Garten	571			1	2	3	761					0			
	Newtonmore	1177	2	2		3	7	673					0			
	subtotal	3009	3	5	1	5	14	860	0	0	0	0	0			
Lochaber	Acharacle	563		2	1	1	4	563			1		1			
	Glenborrodale	105		2			2	210					0			
	Kilchoan	157			1		1	628			2		2		2	
	Ardgour	176					0	#DIV/0!					0			
	Lochaline	344		2			2	688					0			
	Glenuig	400					0	#DIV/0!					0			
	Eigg	75					0	#DIV/0!					0			
	Spean Bridge	1203	2	1	2	1	6	802			1		1			
	Muck	75					0	#DIV/0!					0			
	Knoydart	60					0	#DIV/0!					0			
	Strontian	543		3	2		5	434					0			
subtotal	3701	2	10	6	2	20	740	0	0	4	0	4	3701	2	7402	
Caithness	Bettyhill	553		2			2	1106					0			
	John O'Groats	512		1		1	2	1024					0			
	Dunbeath	472		1		3	4	472				2	2		2	
	Lybster	1246	2	2	2		6	831			2		2			
subtotal	2783	2	6	2	4	14	795	0	0	2	2	4	2783	2	5566	
Sutherland	Tongue	503	1			2	3	671				1	1			
	Achfary	53					0	#DIV/0!					0			
	Bonar Bridge	1305	6	3	5		14	373	1		2		3			
	Durness	353			2	1	3	471					0			
	Helmsdale	921	1	1	2	1	5	737					0			
	Kinlochbervie	464		1	2	1	4	464					0			
	Lochinver	1047	1	3		1	5	838					0			
	Scourie	250				1	1	1000					0			
	subtotal	4896	9	8	11	7	35	560	1	0	2	1	4	4896	0	#DIV/0!
Orkney	Eday	270		1			1	1080					0			
	Longhope	300	3				3	400					0			
	Rousay	302			1		1	1208					0			
	Sanday	320				1	1	1280					0			
	St Margarets	2214	1	1	1		3	2952					0			
	Hope															
	Stronsay	270					0	#DIV/0!					0			
	Shapinsay	307	1	1			2	614					0			
	Westray	375					0	#DIV/0!					0			
	Flotta	300					0	#DIV/0!					0			
	North Ronaldsay	320					0	#DIV/0!					0			
Papa Westray	375					0	#DIV/0!					0				
subtotal	5353	5	3	2	1	11	1947	0	0	0	0	0	#DIV/0!	0	#DIV/0!	
Shetland	Baltasound	990			1	1	2	1980					0			
	Bressay	346				1	1	1384					0			
	Fetlar	87					0	#DIV/0!					0			

Appendix B : Rates of fire and casualty in Highlands and Islands Volunteer Areas, 1994-1997

District	Village/unit	Number of residents	Dwelling fires per village				Total for 4 years	Annual rate of fires per n residents (1 fire per n residents p.a)	Dwelling fire casualties, deaths & rescues				Total for 4 years	Annual rate of casuatly per n Residents (1 casaulty per n residents p.a)	Fatalilit-ies	Annual rate per n residents (1 fatality per n residents p.a)
			Year						1994/95	1995/96	1996/97	1997/98				
	Hamnavoe	1029				1	1	4116				1	1		1	
	Hillswick	857	1	1			2	1714					0			
	Mid Yell	1055	1	1	1		3	1407					0			
	Sandwick	848				2	2	1696				2	2			
	Scalloway	2183	2	3		2	7	1247				1	1			
	Sumburgh	2385		2	1		3	3180					0			
	Walls	689	2	3		1	6	459					0			
	Whalsay	558		1	1	3	5	446					0			
	Bixter	795		1			1	3180					0			
	Skerries	558					0	#DIV/0!					0			
	subtotal	12380	6	12	4	11	33	1501	0	0	0	4	4	12380	1	49520
All districts	Total	67103	58	72	66	60	256	1048	7	4	11	10	32	8388	7	38345

Mull

Table B.3 provides a breakdown of census data and numbers of fire and fire casualties for the whole of Mull, including Tobermory which is served by a retained fire unit. There were no reported fire deaths on Mull, and no reported fire casualties in the areas attended by the 4 auxiliary units in the period 1992-1996. There was one fire fatality in each of 1987 and 1991. Thus the fatality rate depends on which period is chosen, ranging from nil in the period 1992-1996 to 1 in about 8,000 if the preceding 5 year period is considered, or a rate of 1 in 15,700 persons per year for the 10 year period.

Table B.3: Summary of dwelling fire and casualty data for Mull

Station/area	Number of residents	Number of FDR dwelling fires (1992-96)	Number of dwelling fire casualties	Annual rate of fire per n residents	Annual rate of casualty per n residents
<i>Tobermory</i>	1087	17	0	320	
Salen	510	2	0	1275	0
Craignure	338	5	0	338	0
Bunessan	288	5	0	288	0
Iona	160	1	0	800	0
Remainder of Mull	757	-	-	-	0
Total	3140	30		523	

Rates of fire and casualty in Mull as a whole

The judgement regarding the level of dwelling fire risk on Mull depends on whether it is assessed using the rate of fire per dwelling alone, or whether account is taken of the number of casualties. If the risk is assessed solely on the basis of rate of dwelling fire, at 1 per 523 residents (about 1 per 240 dwellings) it would be judged to:

- fall into the region classed as “**high**” by the JCACR research, and
- be above the average for the UK as a whole and for Scotland as a whole.

The rate of fire per dwelling is reasonable close the rate reported for the Highlands and Islands as a whole, namely 1 per 523 versus 1 per 450, suggesting that the risk in these areas is comparable.

There were no fire casualties in any of the 4 villages served by volunteer units in the period 1992-96, which would indicate “low risk”. Clearly care has to be taken in interpreting the

casualty data. If national ratios of fires to fire casualties held true, there would normally be only 2 to 3 fire casualties with 13 dwelling fires. If the ratio of 1 casualty to 10 fires, as observed in Highlands and Islands, is applied, there would normally be about 1 casualty with 13 fires. Thus, it is argued here that the fire risk in these 4 villages cannot be reliably gauged on the basis of the reported fire casualties in 1992-96.

Indeed, the rate of fire death would be classed as very high, at 1 per 17,720 persons per year. Again, care must be taken in relying on this statistic as it is based on only 2 incidents. This would be interpreted as falling into the intolerable region of risk, where risk should be reduced by a factor of 3 (ie a 70% reduction in fire deaths) at least until it falls into the "tolerable region", at which point further risk reduction should be pursued until the cost of further risk reduction is grossly disproportionate to the benefit.

Risk rating volunteer areas on Mull

If attention was to focus on dwelling fires alone in auxiliary areas, the rate of dwelling fire in these 4 villages would again be classed as **high**, with 13 dwelling fires in 4 years in the volunteer unit villages, i.e. an annual rate of 1 per 632 residents (about 1 in 290 dwellings). However, with less than 3,000 residents in the areas on Mull served by volunteer units, it is reasonable to apply the same rating for Mull as applied to the Highlands and Islands. Therefore, it seems reasonable to class the risk as medium, on the balance of these indicators.

The number of dwelling fires has remained fairly stable at about 6 or 7 per year across Mull. Indeed, the number of dwelling fires in 1987 was 13 compared with 6 in 1996, suggesting the risk has remained stable over recent years.