THE VALUE OF SPRINKLERS TO THE ECONOMY

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SCIENTIFIC ADVISORY BRANCH

MEMORANDUM 2/79

FIRE RESEARCH

THE VALUE OF SPRINKLERS TO THE ECONOMY

BY

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SUMMARY

Sprinklers have a value to the economy equal to the net savings they produce. This report investigates the value of sprinklers in manufacturing industry. The costs and benefits associated with no sprinkler protection, the current level of protection and an ideal optimum level of protection are calculated and results produced for several individual industries as well as manufacturing industry as a whole. The results show that the current level of sprinkler protection is of value to the economy and that considerable further benefit could be derived from increasing protection to the optimum level.

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February 1979

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1. INTRODUCTION

This memorandum is part of a detailed analysis of the value of fire protection measures to the national economy. Other reports present detailed results showing the value of sprinklers in different building types. This report presents a brief resumé of the consequences of varying the level of sprinkler protection in different sectors of manufacturing industry. In particular 3 levels of protection for industrial production buildings are considered;

1. The current level of sprinkler protection.

2. The level of sprinkler protection which gives the greatest total economic benefit.

3. No sprinkler protection.

These 3 options are analysed for all manufacturing industry and for several of the more important SIC groups.

2. METHODOLOGY

2.1 Definition

The value to the economy of a particular level of sprinkler protection is the net savings it brings. That is

Value = Saving in fire losses due to level of protection - Cost of providing protection

These two quantities, savings and cost, are calculated as shown below.

2.2 Calculating the savings due to sprinklers

In any building the loss due to fire in any year can be expressed as

$$l = p\,L\,A$$

where l is the fire loss/year in £

A is the expected area of damage per fire

L is the average loss per unit area of fire damage

p is the expected number of fires which will occur in this building in a year.

If the building is sprinklered the expected area of damage per fire is different from the area in an unsprinklered building. So

Fire loss/year in unsprinklered building. = p L Au

Fire loss/year in a sprinklered building. = p L As

Where Au and As are the expected areas of fire damage in unsprinklered and sprinklered buildings respectively.

The parameters p, L, Au and As have all been calculated for various occupancies and industry groups (see SAB Report 17/78 - The Value of Fire Protection in Buildings - Summary Report). The parameters p, Au and As are functions not only of the occupancy group but also of the size of building involved.

The above calculations for a single building may be extended to any number of buildings. For N buildings (all the same size) of which n are sprinklered, the total fire loss is then given by:-

Total Fire loss with n buildings sprinklered = n p L As + (N-n) p L Au

If however no sprinklers were present in any building -

Total fire loss with no sprinklers = N p L Au

So, the saving in fire loss/year due to this level of sprinkler protection, s, is:

Total loss with no sprinklers - Total loss with sprinklers = n p L Au - (n p L As + (N-n) p L Au)

$$s = n\ p\ L\ (Au - As)$$

This calculation assumes all the buildings involved are of the same size. To calculate the total saving (S) due to sprinklers in a particular industry the individual savings possible in buildings of different sizes need to be summed for all the buildings in the industry, ie

$$S = \sum_{\text{all } B} \$(B)$$

where B is building size (total floor area)

The number of buildings of any particular size in an industrial group and the number of these buildings which are sprinklered, are obtained from the SAB survey of manufacturing industry (SAB Report 10/78). The actual savings due to the current level of protection can hence be calculated as well as the savings due to any other, assumed, level of protection.

2.3 Calculating the cost of providing sprinkler protection

The cost of providing sprinkler protection has 2 components - the capital costs and the running costs. From discussions with sprinkler manufacturers the average costs below have been found for providing sprinklers for ordinary hazard establishments (1977 prices).

Capital cost = £2000 + £1.98 x Building size in sq. metres

Annual running/maintenance costs = 1% of capital cost

The expression above gives the cost, in 1977 prices, of providing any level of sprinkler protection. When used to find the capital cost of a level of sprinkler protection the cost calculated is effectively that required to install new sprinkler systems in the buildings protected. This is correct for the purposes of this note. The cost quoted should not be thought of as the depreciated value or historic cost of existing systems.

2.4 Combining savings and cost - Net Present Value

The savings due to sprinklers accrue over the whole lifetime of the system, while the bulk of the costs must be met at the time of installation. A true measure of the value of sprinkler protection must take into account not only all the savings and costs but also that expected savings in future years are of less value now than savings in the present year. To achieve this aim the Present Value of savings and costs are used in calculations. Present Values are found using a

standard 10% discount rate for savings or costs in future years.

So, numerically -

Net Present Value of sprinkler protection	=	9.36 x	Savings due to sprinklers in 1 year	- 1.094 x	Capital cost of installing sprinklers.

Note also that to calculate NPVs the full loss to the economy is used - incorporating both direct and consequential losses. For manufacturing industry it has been found that consequential losses are equal to 60% of direct losses. This figure is used throughout this report.

2.5 Levels of sprinkler protection

Using the above we may compare the value to the economy of different levels of sprinkler protection. That is, we may compare the effects of having different numbers of buildings sprinklered - in all cases only complete sprinkler protection (or no protection) of the whole of any building will be considered. This note is concerned with 3 important possible levels of protection - the current level, the 'best' level and no protection.

3. COMPARING COSTS AND BENEFITS

3.1 The current level of protection

The level of sprinkler protection in buildings of different sizes in different industries is available from the SAB survey of manufacturing industry. The value of this level of protection may be found quite easily from these figures, and is given in Section 4 below.

3.2 The optimum level of protection

The optimum level of sprinkler protection for an industry is that which maximises total economic benefit. For some sizes of buildings there is a net cost involved in installing sprinklers. The optimum level of protection therefore only involves improving protection of buildings above a certain size.

For the calculations in this note we consider the effects of improving current levels of sprinkler protection. That is, the costs and benefits of installing additional sprinkler systems where justified, but not removing systems in small

buildings which are theoretically uneconomic. When considering the current building stock this is sensible as it is not practical to expect people to remove sprinklers from existing buildings. However if considering new, unsprinklered, buildings the true optimum level of sprinkler protection would not include sprinklers in small buildings at all. There is however very little difference in the two approaches as, in reality, very few small buildings are sprinklered and the losses in small buildings are low. The two approaches produce only about a 5% difference in the final NPV figures. Therefore the term "optimum level" will be used to describe the best level of protection possible starting from current levels, as this is a more realistic interpretation.

4. RESULTS

4.1 Current level of protection

The results (Table 1) show that, overall, 36% of all manufacturing industry is already covered by sprinkler systems and this is estimated to have the effect of reducing direct fire losses from £90 million a year to £67 million a year (all monetary values are in 1977 prices). This level of protection is achieved at a capital cost of £156 million. In terms of overall value to the economy this cost is more than offset by the present value of the yearly savings over the lifetime of the sprinkler system.

4.2 The optimum level of protection

Table 1 also shows that further benefits accrue if sprinkler coverage is increased to the economically optimum level. This optimum level provides sprinkler coverage for 93% of the total floor area of manufacturing industry. At this level losses are reduced to £33 million per annum at an extra capital cost of £235 million.

For individual industries the present level of coverage is variable - from 80% in Other Manufacturing to 15% in Mechanical Engineering. However, in all but one of the industries investigated, there is a positive net benefit to the economy due to the current level of protection. The only exception is Chemical and Allied Industries where the calculated fire losses associated with no protection are lower than the losses calculated for the current level of protection. This result is due to the

detailed form of the expression for average area in sprinklered fires in this industry, where there is a relatively high probability of sprinkler failure.

Increasing the level of coverage increases the value of sprinklers much more in some industries than in others. In particular Food, drink and tobacco, Mechanical Engineering and Vehicles all achieve large reductions of 75%-85% in fire loss for the extra costs involved. Other industries such as Other Manufacturing and Paper and printing show smaller savings because they are already well protected by current sprinkler systems and the reductions possible by changing to an optimal arrangement are less than in other industries. Some industries, for example, Electrical Engineering, show large reductions in fire losses (about 70%) but the extra capital costs involved negate much of the saving. This is because the absolute level of fire loss in these industries is quite low, so the cost of installing extra sprinklers is high in comparison to the sums saved.

4.3 Other occupancies

The present level of sprinkler protection is not known for occupancies other than manufacturing industry, therefore, no detailed calculations are shown for other occupancies. However, it is known that only large shops and high risk storage buildings benefit from sprinkler protection and that the majority of the savings possible are in manufacturing industry.

4.4 Conclusions

1. The current level of sprinkler coverage in manufacturing industry is of net value to the economy. A reduction in fire losses of £23 million per year, compared to a loss of £90 million with no protection is achieved for a capital cost of £156 million (all figures at 1977 price levels).

2. If sprinkler coverage were to be increased to the economically optimal level there would be considerable extra benefit to the economy, with direct losses reduced by a further £34 million per annum for an additional £235 million capital cost.

3. The industries which would achieve the greatest reductions in direct loss from improved protection are:

Food, drink and tobacco	85% reduction in direct losses
Mechanical Engineering	75% " " " "

Vehicles	85% reduction in direct losses
(and also Electrical Engineering	70% " " " ")

4. In some industries where fire losses are relatively low or are already greatly reduced by sprinkler protection, there is less net benefit to be obtained from increasing the level of protection than in other industries.

TABLE 1 THE EFFECT OF SPRINKLER PROTECTION IN INDUSTRIAL PRODUCTION BUILDINGS

(all costs and benefits at 1977 prices)

		No Protection	Current Sprinkler Protection Level					Sprinkler Protection Level Giving Maximum Economic Benefit					
Industry Group	Approximate No of fires pa	Direct Losses pa if no sprinklers (£ millions)	No. of Buildings Currently Sprinklered [1]	% Total Floor Area Sprinklered	Capital cost of current protection (£ millions)	Direct Losses pa with current protection (£ millions)	NPV of Current Protection [3] (£ millions)	Building Size Above Which Sprinklers are Justified (M^2)	No. of Buildings Sprinklered at optimum level	% Total Floor area Sprinklered	Capital cost of change from current level (£ millions)	Direct Losses pa with optimum level (£ millions)	NPV of change from current level of protection (£ millions)
All Manufacturing Industry [4]	7400	90	16000	36	156	67	174	800	43500	93	235	33	258
Food, drink and tobacco	570	17.3	970	17	10	12.2	65	200	5000	100	25	1.7	130
Chemical and allied	710	6.4	270	53	14	6.9	-23	199 (up to 4500) [2]	3000	97	7	5.5	13
Mechanical Engineering	380	12.1	550	15	6	10.6	16	1850	3400	78	36	2.5	82
Electrical Engineering	260	6.2	800	48	12	4.2	17	200	3700	100	17	1.2	26
Vehicles	450	9.9	460	36	8	6.6	41	1000	1700	94	16	0.8	69
Metal Goods not elsewhere specified	820	7.6	520	17	7	6.9	3	400	[illegible]	98	39	2.8	19
Textiles	1090	13.6	2000	67	20	10.8	20	700	4400	96	24	6.9	32
Timber and Furniture	600	9.7	2640	59	19	3.4	74	200	5700	100	10	1.5	18
Paper, Printing etc	470	6.1	1610	63	20	2.8	28	1550	2300	81	5	2.1	5
Other Manufacturing	500	10.5	2070	80	18	3.3	88	10	3200	100	3	2.4	10

NOTES

1. For these calculations a partially sprinklered building has been counted as ½ a fully protected building - so "No. sprinklered" = No. fully sprinklered + ½ x No. partially sprinklered.

2. In the chemical industry sprinklers are also found to be uneconomic in large buildings.

3. NPV calculations include consequential losses, and annual sprinkler maintenance costs.

4. Due to the averaging of many different industries in calculating the figures for All Manufacturing Industry the overall results for this group should not be compared with the figures for individual industries.

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