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FAILURE RATES OF AUTOMATIC FIRE DETECTION AND ALARM SYSTEMS

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INTRODUCTION

During 1968, local authority fire brigades in Great Britain were asked to participate in a survey that was intended to bring together (among other things) reports on all fires starting in premises equipped with automatic fire detection systems.

All the reports received have been examined to establish, so far as possible, how often a fire occurred and either (a) there was a complete failure of the automatic system because it was not in a serviceable condition (Total Failure); (b) there was a local alarm indication provided by the system, but a failure in the brigade connection because the connection was not in a serviceable condition (Brigade Connection Failure), (c) the system operated, or would have done if the fire had not been discovered at an early stage by a person. All reports on false alarms, or on fires in premises equipped with manual fire alarm systems or fixed installations such as sprinklers, have so far as possible been excluded.

METHOD

All the special report forms were examined, particular attention being paid to those where the instructions on completion seemed to have been misinterpreted or were inadequate. Incidents were reclassified according to the apparent circumstances, subjectively interpreting the limited descriptive information available. Occasional reference was also made to the standard report forms received on all fires, but these added little to the picture.

Although it was intended in the original survey (1) to distinguish between fires where the automatic system gave the first warning and those where it did not, careful consideration disclosed ambiguity in a large proportion of the special reports, and it is not now felt possible to separate these two categories. If a person discovers a fire in protected premises before it has grown to a sufficient size to operate the automatic system, the system may be regarded as having 'failed'. Since there is clearly an optimal sensitivity, these cases are of less concern than the Total and Brigade Connection Failures, where the system failed to operate because of unserviceability. They are accordingly referred to as Sensitivity Non-Operations or Late Operations, grouped in this note with "System discoveries".

It is possible to identify several Total and Brigade Connection Failures, and where possible this has been done. Additionally, on a very few occasions an apparent sensitivity Non-Operation or Late Operation may have concealed a condition of unserviceability, (i.e. a Total Failure). Nearly all alarm systems provide for an alarm to be transmitted, as soon as it is raised, to the public fire brigade. (The main exception would be where a well-equipped private fire brigade investigates first).

We recognise, therefore, three degrees of failure (a) Total Failure; (b) Brigade Connection Failure; and (c) Sensitivity Non-Operation or Late Operation.

The Brigade Connection Failure is in principle less serious than the Total Failure, because there is at least a possibility that somebody at the protected premises may call the fire brigade earlier than would otherwise have been the case, or even control a fire satisfactorily after being warned by a local alarm. The importance of the Sensitivity Non-Operation and Late Operation is not amenable to assessment, as it will normally occur due to the fortuitous presence of a person or persons who detect the fire at an early stage. These cannot in any case be regarded as positive identified failures of the system.

The apparent performance of the automatic detection and alarm system in the fires reported is given in Table 1. Since not all fires (for example, small fires) may have been reported, and since not all reports (for example, involving Sensitivity Non-Operations or Late Operations) may have been recognised as relevant to the investigation, these figures should be regarded as rather approximate.

Summaries of the basic reasons for reported failures are given in Tables 2 and 3.

RESULTS

It is necessary to reiterate that all the following statistics are approximate, since it was necessary to use subjective interpretation for a large number of reports.

Table 1

System performance in relation to fires reported*

		Heat	Smoke	Total
(a)	Total Failures	7	1	8
(b)	Brigade Connection Failures	4	4	8
(c)	Near-Failures (Appendix 1)	1	1	2
(c)	Sensitivity Non-Operations*** and Late Operations (person detected fire) System discoveries	272**	170**	442
	System detections of fire outside protected area	2	1	3

*An additional 16 reports were submitted on fires which started outside a protected area and were not detected.

**Each of these figures includes an arbitrarily allocated 10 fires from a total of 20 reported in premises protected by a heat and smoke system.

***Possibly including a few occasions when the system was not in an operable condition.

Table 2

Reasons for Total Failure

	No. of cases
Connection by direct line	
Disconnected - alterations to building (heat)	3
Disconnected - work on system (heat)	1
Faulty detector head (heat)	1
Faulty control unit (heat)	1
Connection by exchange telephone	
Disconnected - work on system (heat)	1
Faulty detector head and faulty control unit (smoke)	1
Total	8

Table 3

Reasons for Brigade Connection Failure

	No. of cases
Connection by direct line	
Disconnected - subscriber unaware not yet connected (smoke)	1
Disconnected - reason not stated (smoke)	1
Faulty control unit (smoke)	1
Faulty line (heat)	1
Reason not known (heat)	1
Connection by automatic dialler	
Disconnected - reason not stated (smoke)	1
Faulty automatic dialler (heat)	1
Connection by exchange telephone	
Alarm mistaken for test (heat)	1
Total	8

DISCUSSION AND CONCLUSIONS

In about 460 fires reported in protected premises, it would seem that the automatic detection and alarm system installed was incapable of warning the public fire brigade in only about 16 (3.5 per cent), and (included in the above) incapable of warning anybody in only about eight (1.7 per cent). Since a system may occasionally have been unserviceable when a person detected a small fire, these may be slight underestimates.

Although the reasons for unserviceability were rather varied, it appears that direct human failures, particularly failing to take adequate precautions over disconnection, are about as common as failures of the technical kind.

REFERENCE

1. FRY, J. F. and EVELEIGH, Christine A. The behaviour of automatic fire detection systems. Ministry of Technology and Fire Offices' Committee Joint Fire Research Organization Fire Research Note No.810. Boreham Wood, 1970.

APPENDIX I

Near-failures

1. Smoke detection system, connected to brigade by direct line.

   Brigade informed subscriber of 'fault' indication. Subscriber checked, found fire, called brigade. (Indication changed to 'fire' shortly after).

   It is felt that this should not be counted as a total failure, because the automatic system brought the fire to attention sooner than it would otherwise have been.

2. Heat detection system, connected to brigade by direct line.

   Due to a number of false calls the brigade connection had been disconnected. It was reconnected by the subscriber upon receipt of a local alarm.

   It is felt that this should not be counted as a failure of the brigade connection, because the brigade connection brought the fire to the attention of the brigade sooner than it would otherwise have been.