

Executive Summary

This Executive Summary describes the project “The effectiveness of sprinklers in residential premises” commissioned by the Buildings Division of the, Office of the Deputy Prime Minister (ODPM) carried out by FRS. Any views expressed in this report are not necessarily those of the ODPM.

Full details of this study and its findings are given in BRE report No 204505.

The overall aim was to determine the benefits and effectiveness of sprinklers in residential accommodation. To achieve this, the project was divided into stages: a Pilot Study, Cost Benefit Analysis, Benchmark Tests and an Experimental Programme. This project was guided and reviewed by a Steering Group.

The members of the Steering Group included representatives from government regulators, the sprinkler industry, the water industry, the housing industry and the fire service. They provided general advice and review on all aspects of the project methodology, and specific advice on sprinkler installation and water supply costs for the cost benefit analysis phase of the project. Also, there was a smaller experimental working group.

The Pilot study included an analysis of statistical information. A strong correlation was observed between the risks of death and injury per fire, and the area damaged by the fire. This formed the basis for an indirect estimate of sprinkler effectiveness as it was not possible to provide a direct estimate of sprinkler effectiveness from the UK fire statistics. Experiences with residential sprinklers in other countries were also reviewed.

Cost benefit analyses including uncertainty analyses have been performed for a range of domestic and residential building types, including houses, flats, various types of houses of multiple occupation, and residential care homes. Further analyses were performed for different building heights, within certain of the broad categories in this list, in order to focus on properties that would be expected to have higher than average risks from fire. The potential benefits of sprinklers include the prevention of deaths and injuries, the reduction of property damage and costs include installation; provision of water supplies and annual maintenance.

Tests were carried out to establish a benchmark fire test for UK conditions to support the further development of British Standard Drafts for Development DD251 (Sprinkler systems for residential and domestic occupancies - code of practice, April 2000) and DD252 (Components for residential sprinkler systems - specification and test methods, July 2002) and to assess the performance of residential sprinklers in fire test conditions.

A series of 18 fire tests was conducted, based on the procedures given in DD 252 to examine the effect of varying parameters on the performance of residential sprinklers. The stylised fuel package was intended to simulate furniture and wall linings, and was characterised using calorimetry. The parameters investigated were: sprinkler model (four pendent types), location of the fuel package within the sprinkler spray, the effect of the presence of lintels, and the sprinkler water flow rate (3 or 4 mm/min).

An Experimental programme, burning realistic residential fuel arrays was conducted to examine and quantify the effectiveness of residential sprinklers, in particular to life safety in the room of fire origin. The effectiveness of the sprinklers was primarily assessed by measuring their ability to control toxicity, temperature and visibility.

8 house lounge fires were conducted inside a two-storey house with a loft conversion, with and without sprinklers. Smoke alarms were present. Fire tests were performed in a standard lounge and an open plan lounge arrangement.

29 compartment fires were conducted inside a room connected to an adjoining single storey volume via a doorway, with and without sprinklers. Smoke alarms were present. The fire scenarios were: a) Lounge, nightlight and television fire- shielded, b) Lounge, fire under table directly beneath sprinkler- shielded, c) Bedroom, fire on duvet- unshielded and d) Lounge, fire on sofa (compliant with 1988 Furniture Regulations)- unshielded. An unshielded oil pan fire kitchen scenario was also examined, with and without sprinklers. Each of these fuel packages were characterised using calorimetry.

The effects of fire room door open/closed, compartment size, sprinkler model, sprinkler orientation and water flow rate were also studied. The flow rates were 60 or 42 l/min for a single sprinkler for standard compartment, and 60 l/min for a single sprinkler or 84 l/min for two sprinklers operating, for the large compartment and open plan lounge arrangement.

The main findings of the project are:

- For the majority of scenarios experimentally studied, the addition of residential sprinkler protection proved effective in potentially reducing casualties in the room of fire origin and connected spaces
- Sprinkler protection was not found to be a complete panacea, slow growing and shielded fires can be a problem
- Smoke alarms, fitted in the room of fire origin, responded typically in half the time required by sprinklers and well before the conditions had become life threatening
- Closing the door to the room of fire origin, was found to be effective in keeping tenable conditions in connecting spaces
- Residential sprinklers are probably cost-effective for residential care homes (old persons, childrens and disabled persons care homes)
- Residential sprinklers are probably cost effective for tall blocks of flats (eleven storeys and above)
- Residential sprinklers are not cost-effective for other dwellings
- In order for sprinklers to become cost-effective, high risk buildings may be targeted, and justified on a case-by-case basis using the cost-benefit approach developed in this project
- In order to be cost effective in a broader range of dwellings, installation and maintenance costs must be minimal, and/or trade-offs may be provided to reduce costs by indirect means.
- In general, the cost benefit conclusions from other countries' experiences were the same as this project, i.e. that sprinklers were not cost-effective, unless systems were low-cost or trade-offs could reduce costs.
- A number of issues relating to the procedures for the fire test in DD 252 have been identified, for submission to BSI.

The emerging results of this study were presented at a seminar in December 2003. Recommendations for further work include evaluation of the effectiveness of concealed sprinklers in residential premises and a cost benefit analysis of residential sprinklers as a compensatory feature.