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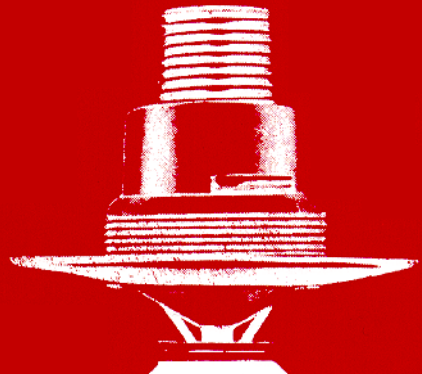
RESIDENTIAL FIRE SPRINKLERS RETROFIT DEMONSTRATION PROJECT



Final Report

Phase I: Multifamily Structures

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNITED STATES FIRE ADMINISTRATION

FINAL REPORT

RESIDENTIAL FIRE SPRINKLERS RETROFIT DEMONSTRATION PROJECT

Phase I: Multifamily Structures

Cooperative Agreement No. HA-12963

U.S. Fire Administration
Emmitsburg, MD 21727

NAHB National Research Center
Project No.: 2091

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INTRODUCTION

The United States Fire Administration's (USFA) goal is to reduce the number of fire deaths and injuries occurring annually in the U.S., particularly among those populations that face disproportionately high risk of death due to fire. They include children, minorities, the elderly, and handicapped persons. The USFA believes that the total number of fire deaths and injuries can be substantially reduced through the application of residential fire suppression systems (including fire sprinklers) in dwellings of all types. Thus, quick response fire sprinkler systems, state-of-the-art in residential fire suppression technology, were the focus of a research partnership between the USFA, the United States Department of Housing and Urban Development (HUD), and the NAHB National Research Center (Research Center). The goal of the two-phase program was to investigate and document the technical and administrative barriers to retrofitting fire suppression systems in existing buildings that house the targeted groups; and, to contribute to other research on the technical, economic, and policy issues surrounding residential fire suppression. More importantly, the USFA can use information gained from this project to formulate strategies for future technical assistance programs and to provide useful technical information to local fire departments and other local public and private organizations.

This is a report on the findings from Phase I, which focused on multifamily structures. Phase II, already in progress, is concentrating on single-family homes. A companion report from Phase II will be available from USFA in the near future. Five sites around the U.S. were selected as Phase I recipients of USFA/HUD grants for funding of building rehabilitation and fire sprinkler system installation. Each grant was comprised of two parts: monies for sprinkler system installation; and, a smaller part earmarked for a local public education, or *Outreach* effort. The type of Outreach program done at each site was largely at the discretion of the local grantee, and included such things as fire sprinkler brochures, installation training sessions, slide shows and videos, and local media events.

The material on the following pages represents a summary of the information gathered and lessons learned by the Research Center from the project. It includes their findings, a report of the various installation costs encountered, and finally a list of problems and recommended solutions. Additionally, the Research Center assembled site-specific

information from the project into *Case Studies* for each site. The case studies detail the project history, community characteristics, sprinkler system design, installation, and costs, as well as local outreach efforts. Copies of the case studies are available from the USFA in a separate publication.

BACKGROUND

Fire sprinkler systems were installed in six multifamily buildings housing a total of 51 low-income households in the following five urban jurisdictions:

Austin, Texas;
Boston, Massachusetts;
Harrisburg, Pennsylvania;
Prince George's County, Maryland; and
St. Louis, Missouri.

The size of the subject buildings range from a 1,280 square foot (sf) two-family duplex with no basement (Austin) to a 21,600 sf double-sided four-story structure with 22 residential units, an office, and a basement (Boston). Residential units varied in age, size, shape, and amenities both within the buildings and among them. Existing conditions among the buildings varied from vacant and condemned in St. Louis to occupied with few substantial problems in Prince George's County. The oldest building participating in the project was located in St. Louis and was dated circa 1880, while the most recent construction, located in Prince George's county, was built around 1965. Construction type and materials were generally ordinary, mostly wood frame or masonry construction. The variety of characteristics encountered, such as size, construction, existing conditions, and uses of the buildings provided a broad range of retrofit experiences, and generated a wealth of information about the installation of fire sprinklers in multifamily residences undergoing rehabilitation. At the end of this report, *Fact Sheets* are provided which include photographs, names, phone numbers, and other information pertaining to each site participating in the project.

In general, the sprinkler installations at each site could be classified as either NFPA-13, or NFPA-13D system, *(NFPA-13: Standard for the Installation of Sprinkler Systems; NFPA-13D: Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and*

Mobile Homes), or some suitable combination of the two, based on the judgement and stipulations of the authority having jurisdiction.'

A basic design premise of residential fire sprinkler design is to suppress incipient fires for up to 10 minutes in the room of fire origin. Ten minutes is predicted to be sufficient time to allow the occupants to escape to safety and allow firefighters to arrive on the scene. The ability of residential suppression systems to meet this requirement rests in the development of quick-response sprinkler heads. A typical quick response head suitable for residential applications is shown in Figure 1. The quick response head differs from typical commercial sprinkler heads in the material properties of the triggering mechanism. Most sprinkler head manufacturers now offer quick response heads for residential systems. Also, the form and profile of the heads have been designed to be less obtrusive to the interior design of the space.

Figure 1. Typical Quick Response Pendent Type Head for Residential Applications. (Courtesy of the Viking Corporation)

[1]On January 13, 1989, the National Fire Protection Association (NFPA) released the first edition of NFPA-13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to Four Stories in Height* with an effective date of February 6, 1989. The Standard is meant to apply to low-rise residential facilities, typical of the buildings involved in this project. It was not formally released in time to be employed as a design guideline by those involved in this project.

SUMMARY OF IMPORTANT FINDINGS

The Research Center's primary role in the project was to provide technical assistance to the grantees, and generally facilitate the incorporation of residential fire sprinkler systems (RFS) into the six targeted buildings. In the course of the project, useful information was generated regarding the technical and regulatory barriers, design criteria, costs, and other practical aspects of retrofitting fire sprinkler systems in multifamily buildings. Some or all of this information may assist the USFA in formulating future approaches and strategies to the residential fire problem. The major findings of the project are summarized below.

- *Building Owners' Criteria.* In the decision-making process leading to installation of sprinkler systems, building owners, especially those that do not reside at the building, generally use economic benefits as the primary criteria. Possible benefits included reduced property insurance costs, higher rents and/or shorter vacancies, flexibility of building code requirements, and reduced probability of uninsured fire losses.

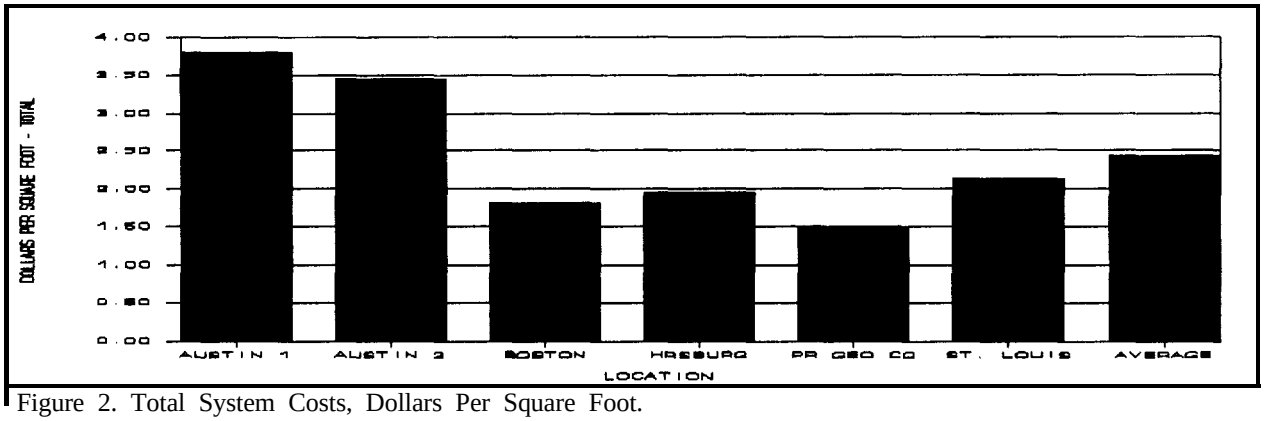

Figure 2. Total System Costs, Dollars Per Square Foot.

- *Cost Sensitivity.* Installation costs are generally higher if a building is not undergoing substantial "gut" rehabilitation because of the need for additional work to accommodate sprinkler installation. Gut rehabs, for example, lend themselves to easier installation because of the access given to inner wall cavities. On the other hand, if wall cavities are not exposed, additional work is typically required to protect the piping or make it more aesthetically acceptable to occupants. The cost of these additional tasks are reflected in the total system costs reported in Figure 2. Furthermore, costs are influenced to some extent by the geometry of the protected spaces. Irregularly shaped areas, or compartments, tend to require supplemental sprinkler heads to achieve the coverages specified by NFPA standards, thus driving

costs upward. Variations in the effective area protected per head are reported in Table I. If the average square foot of area protected per head is considered an indicator of "coverage efficiency", then high numbers are better than low ones. As the table shows, coverages between 75 and 116 square feet per head were achieved at these sites. (For a single ordinary sprinkler head, NFPA-13D allows a *maximum* coverage of 144 square feet, which would be the ideal maximum). As mentioned above, these coverage ratios are largely affected by the uniformity and complexity of the floor plan, and room size.

Table I. Variations in Sprinkler Head Coverages.

	Austin1	Austin2	Boston	Harrisburg	Pr. Geo. County	St. Louis
Total Square Feet Protected	1,280	1,370	21,600	7,100	16,660	8,000
Total Number of Heads	16	16	210	82	143	107
Average Coverage in Square Feet Per Head	80	86	103	87	117	75

SOURCE : NAHB National Research Center

- *Additional Water Capacities.* The total cost of a sprinkler system can be substantially affected by the need to increase the existing water supply to a building to accommodate the sprinkler flow demands. Costs for water supply increases encountered in the project had only small variations. But, the add-on for upgraded service had a far greater relative effect on the costs in small buildings than in large buildings, simply because the bottom line costs in smaller buildings are much less, thus more sensitive to costly add-ons. Figure 3 shows the added costs for providing water service to the fire sprinkler systems.

  Increased supply capacity is provided by adding new taps to the city water mains, upsizing existing ones, or storing water on site. Water departments may charge one-time "tap fees" that can vary proportionately with the size of the new connection.

Subsequently, the additional connections to city water may or may not be metered, depending on local policy. In Prince George's County, for example, the Washington Suburban Sanitary Commission's current policy is not to charge for water used to fight fires; the policy applies to residential sprinkler systems, and is expected to extend to single-family homes as well. In lieu of metered usage, flat monthly fees are sometimes charged for the sprinkler service connection, whether or not water is used.

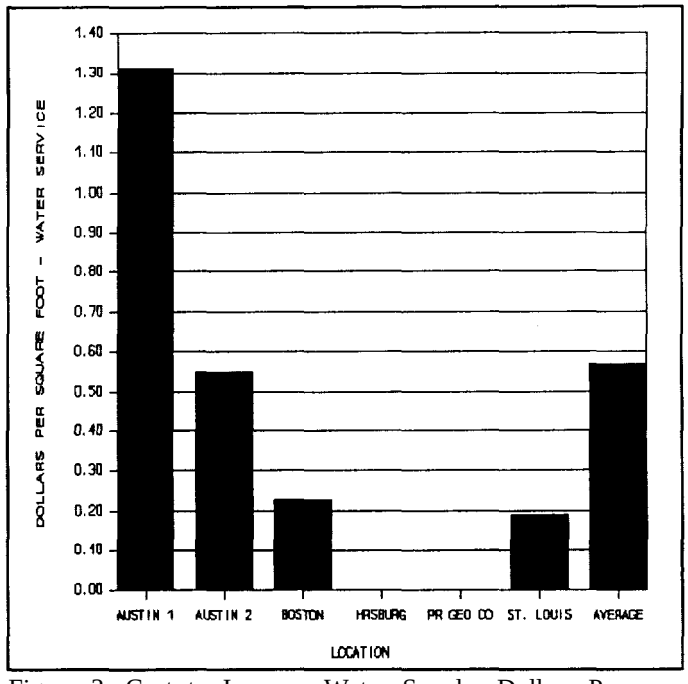

Figure 3. Cost to Increase Water Supply, Dollars Per Square Foot

- *Skill Requirements.* RFS installations can be divided into two distinct tasks: design and installation. The skill requirements for performance of these tasks often overlap. The skills needed for installation of RFS are within the capability of most professional plumbers; for the most part, materials and techniques are ordinary, and typical of other fluid systems they routinely install.

  In general, plumbers do not lack the pipe and fitting know-how to install RFS systems, but rather they lack a working knowledge of the RFS design criteria, i.e. sprinkler location, spacing, hydraulic requirements, etc., as specified in the NFPA-13D and 13R standards. Some jurisdictions require specific licensure of fire sprinkler installers, while others do not. The USFA regularly sponsors workshops at many locations around the country which provide training on the various sprinkler standards. These workshops are expected to continue through fiscal year 1990. The actual attendance of licensed plumbers at these workshops was not investigated in the course of this project. A small attendance of plumbers, if this is the case, would suggest a lack of awareness or understanding of the business opportunities that may

exist in RFS installations. However, licensing requirements are generally governed by local ordinances, and individual inquiries should be made at the local level.

- *System Complexity*. Fire department officials seek to identify the technical similarities between residential fire sprinkler systems and standard residential plumbing systems. They believe that demonstrating the simplicity of design and installation of residential fire sprinklers will provide evidence of their affordability to building owners.

  Furthermore, the installation of residential fire sprinkler systems during building rehabilitation is generally not more complicated than installation of standard residential plumbing systems. Complexity can vary according to building size and use, but when incorporated into rehabilitation plans the installation of fire sprinkler systems is unlikely to complicate the overall rehabilitation of the building. Coordination among the trades involved in the installation minimizes interference of simultaneous activities on the job site.

- *Standard & Codes for Residential Systems.* Given the lack of a sprinkler standard suitable and directly applicable to low-rise residential buildings, standards developed for commercial sprinkler systems (NFPA-13) were often used by local authorities as the basic criteria. Subsequently, the completed systems usually represented a hybrid of NFPA-13 (commercial) and NFPA-13D (one and two-family residences). However, the modifications, uses, and interpretations of the standards varied. In some jurisdictions, it became apparent that there was uncertainty in how the sprinkler standards should be applied to the types of multifamily rehabs involved in this project. The recent emergence of NFPA-13R addresses the gap that previously existed between NFPA-13 and NFPA-130; that gap being represented primarily by small and low-rise multifamily dwellings characteristic of the buildings in this project.

- *Importance of Plastic Pipe & Fittings.* The adaptation of fire sprinkler technologies to multifamily rehabs is favorably influenced by plastic pipe materials. Historically, sprinkler systems were fabricated of iron or steel pipe and fitting materials (many commercial applications still require it). Where code allowed, plastic was the

preferred material due to lower material and installation costs made possible by its flexibility, light weight, and ease of assembly. Two plastic materials are approved for use in residential fire sprinkler systems: polybutylene and chlorinated polyvinyl chloride (CPVC). These plastics are used in other ordinary plumbing applications; their (behavior) and installation techniques are well known and presented little or no challenge in these installations. Four of the five sites involved in this project selected CPVC for sprinkler piping.

- ***Cost Estimates. The*** relative simplicity of residential sprinkler systems allow the costs for a given building to be estimated with reasonable confidence prior to commencement of design or installation. Typically, the largest uncertainty in estimating costs lies in assessing the work and fees necessary for providing adequate water pressure and volume to the system. Local codes, policy, and practices are large determinants of the final costs and should be accounted for in the cost estimation process.

SPRINKLER SYSTEM COSTS - Design, Installation, Operation, & Maintenance.

The identification and study of opportunities for residential fire sprinklers to be cost-effectively added to buildings during rehabilitation was an integral part of this project. The variety of sizes, types, conditions, and uses of the subject buildings created a broad range of information on the various cost factors of residential fire sprinkler systems. The decisions of local officials (fire, water, and building), vendors, and building owners all affected, to some extent, the final costs of sprinkler system design and installation. Table II provides a summary and breakdown of the system costs for each of the project sites.

Table II. Summary of Sprinkler System Costs, By Task and Site.

	Austin1	Austin2	Boston	Harrisburg[2,3]	Pr. Geo. County	St. Louis	AVGS
TOTAL SYSTEM COSTS	5,210	4,403	39,400	13,838	25,160	17,068	17,188
Cost Per SF	3.80	3.44	1.82	1.95	1.51	2.13	2.40
DESIGN	1,100	1,100	2,250	1,750	1,750	1,500	1,575
Cost Per SF	.80	.86	.10	.25	.10	.19	.38
WATER SERVICE	1,800	700	5,000	0	0	1,500	2,250[1]
Cost Per SF	1.31	.55	.23	0	0	.19	.57[1]
LABOR	1,600	1,900	18,090	7,900	14,770	9,168	9,414
Costs Per SF	1.17	1.48	0.84	1.11	.89	1.15	1.12
MATERIALS	710	703	14,060	4,188	8,643	4,900	5,541
Costs Per SF	.52	.55	.65	.59	.52	.61	.56
NO. OF RENTED UNITS	2	2	23	7	15	4	- 0 -
Cost Per Unit	2,605	2,202	1,704	1,727	1,677	4.267	- 0 -

(1) Average of non-zero costs.
(2) Includes the Research Center's estimates of retail materials costs.
(3) Includes residential and commercial spaces.

SOURCE: NAHB National Research Center

Because of the influence of building size on installation costs, a simple comparison of the bottom line does not give an accurate representation of the costs of installing sprinkler systems in multifamily residences; i.e., total cost of the system tells only part of the story. Therefore, it must be adjusted or normalized to account for certain variables. The normalized cost of RFS can be reported in a variety of ways, such as cost per square foot, cost per sprinkler head, or cost per rentable unit. When working within a single building

type with varying sizes, such as multifamily residential, the *cost per square foot of protected area* is most useful. "Protected area" includes not only those areas that are sprinklered, but also areas that were allowed to remain unsprinklered by the local authorities; or, the total area subjected to and approved by the fire department plan review. In most residential systems, this would include the total interior space. For example, a bathroom or closet in a sprinklered building that was not required to be sprinklered would be included as "protected area." The highest installation cost incurred in the project was at Boston with a total system cost of $39,200, with a low of $4,403.00 in Austin-2. However, as shown in the table, the Boston installation was more economical than Austin on a cost-per-square foot basis at $1.81 and $3.44, respectively.

Design Costs

Sprinkler system design was a coordinated effort between the project team in the participating jurisdictions and staff engineers at the Research Center. Figure 4 shows the costs incurred by building owners for design of the system. In Harrisburg and Prince George's County the systems were designed primarily by the Research Center at a cost of approximately $1,750 per building, including a sequence of design revisions resulting from fire department reviews. In the other three cases the project team included private firms who were experienced in sprinkler system design and installation, and hired by the building owner or the grant administrator. In Boston, the sprinkler system plans required review and certification by a professional engineer prior to approval by the local fire department. Cost to the building owner for this service was approximately $250.

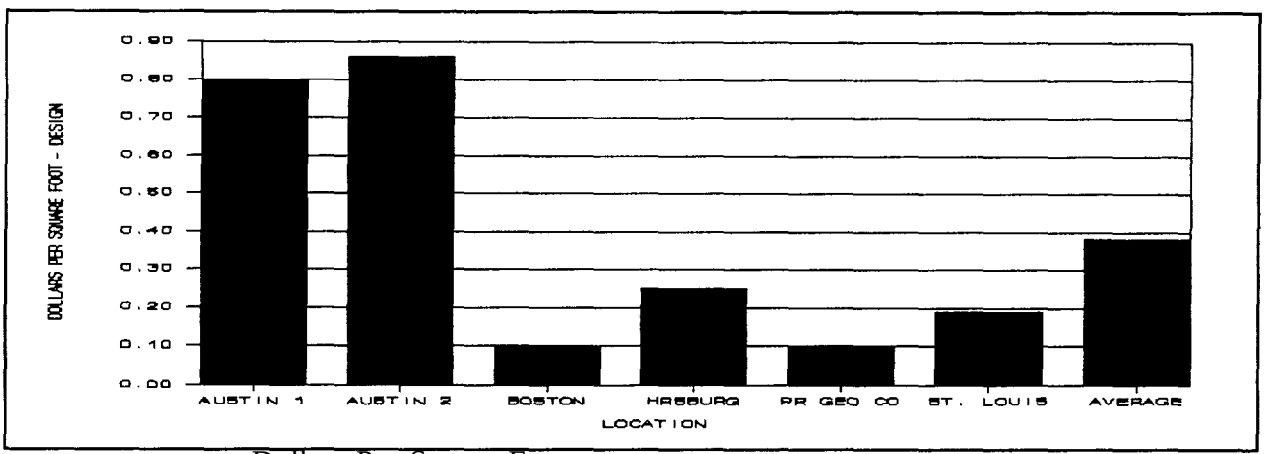

Figure 4. Design Costs, Dollars Per Square Foot.

In general, the design of fire sprinkler systems typical for the buildings involved in this project should cost between $1,000 and $2,000, depending on such factors as the building size and type, its use, and the requirements of specific jurisdictions. These estimates are based on a 30 to 40 hour effort and a design fee between $40 and $50 per hour. As discussed below, structural characteristics can influence design costs, although to a lesser degree than they effect installation costs. The final decisions concerning who would design the systems and prepare schematics rested with local officials, and sprinkler installation could not begin at any site until system plans were approved by the local fire department.

Installation Costs

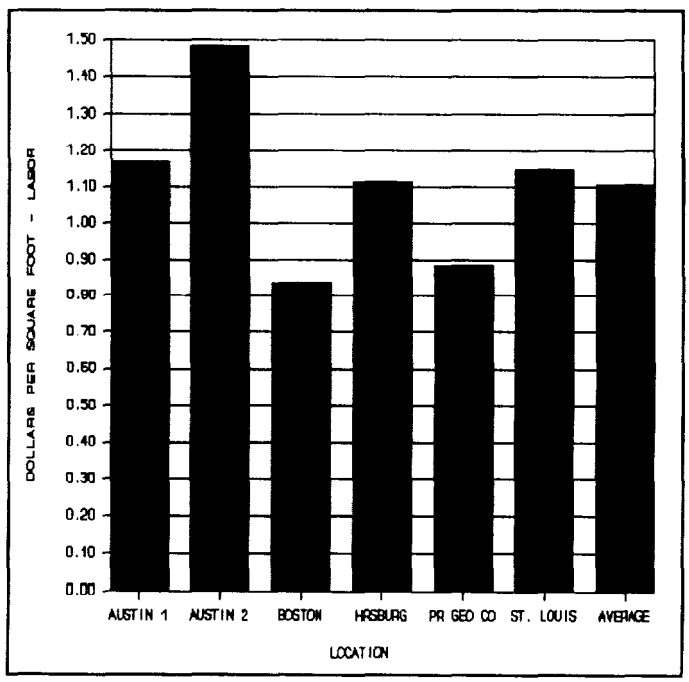

Figure 5. Installation Labor, Dollars Per Square Foot.

Figures 5 and 6 show the costs incurred for labor and materials at the project buildings. In Boston and Harrisburg, the costs of sprinkler installation were lowered due to donation of materials from suppliers wishing to establish a reputation in what they felt was an expanding market niche. Donated materials consisted primarily of pipe, fittings, and sprinkler heads. The research goals of the project necessitated that the Research Center engineers estimate the retail costs of the donated materials in order to give a better representation of the costs of the sprinkler systems. Prior to sprinkler system design, the total costs of design and installation of the systems were estimated for each site by staff engineers at the Research Center. Those estimates were useful in the processes of screening for appropriate buildings and final bid reviews. As indicated by the bars on the far right in Figures 5 and 6, the cost for materials was one-half the cost for labor, on average, at $0.56 and $1.12 respectively.

Several important factors drove the costs in opposite directions. In Austin, Boston, and St. Louis, costs were raised by increased water capacity requirements, with the cost of increasing the water supply having a far greater effect on the costs of installation in the

small buildings in Austin than in the large building in Boston. Boston officials required redundant fire protection systems (in addition to smoke detectors) such as an electric control panel and multiple alarm warning systems. All of the jurisdictions required multiple reviews of system plans. In Harrisburg and Prince George's County, changes in rehabilitation construction to facilitate sprinkler system installation also are considered as costs of sprinkler installation and included in these figures.

Conversely, the *actual* costs of these systems to the building owners were lowered by several factors: (1) the willingness of fire officials to waive some of the more stringent requirements of NFPA 13; (2) donation of materials in Boston and Harrisburg (though as mentioned, the Research Center estimated the extent of the savings attributable to donated materials); (3) reductions in scope or requirements of installation plans after closer evaluation of buildings (Harrisburg); (4) use of sidewall sprinkler heads rather than pendents where water pressure was adequate (Harrisburg, Prince George's County); and, (5) leaving piping exposed in commercial areas (Boston and Harrisburg).

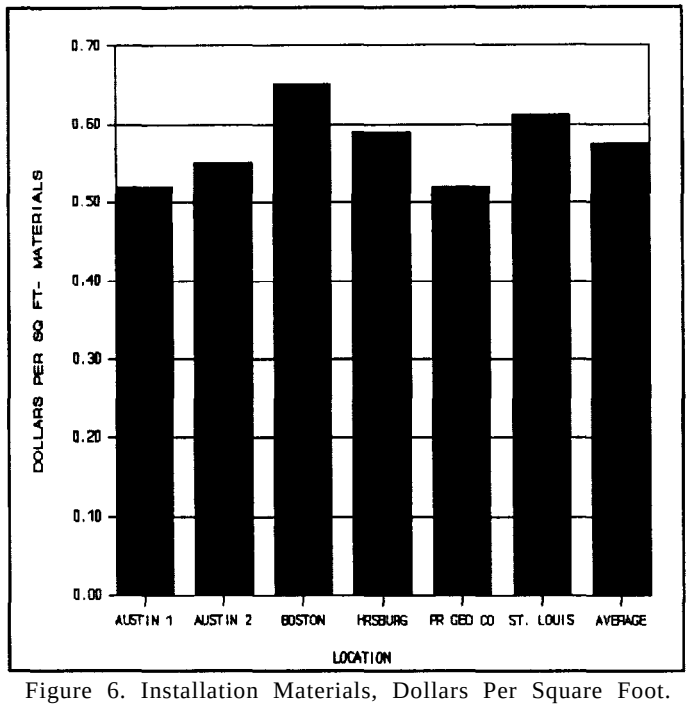

Figure 6. Installation Materials, Dollars Per Square Foot.

Another useful way to analyze the costs of a fire sprinkler system is as an investment by a building owner. In addition to the costs per square foot, an owner may want to know the costs per rentable unit of installing a sprinkler system. Table II shows the *costs per unit* of the sprinkler systems installed during this project. It appears there are economies of scale since the per-unit cost for large buildings with many units is lower than the per-unit cost in the buildings with only two or four units.

Operation & Maintenance Costs

Buildings equipped with fire sprinklers can be subject to various costs whether or not a fire actually occurs. Operational costs may include water department fees, yearly inspections, testing and maintenance, a monitoring and response service, increased property taxes reflecting a higher tax assessment, damage from leakage or accidental discharge, and financing charges when borrowed funds are used to pay for the sprinkler system. Further, in the event of false activation or a fire large enough to cause sprinkler activation there will be costs for replacement of heads, water service (if sprinkler water is metered), as well as water damage repairs.

Of the five jurisdictions participating in the project, only the building in Boston is charged an annual fee for water service to the sprinkler system ($165/year). The other sprinkler systems are connected to the domestic water supply downstream of the meter, thus pay only for water actually discharged through the sprinkler system. The owners of the buildings in Boston, Harrisburg, and St. Louis expect to spend on the order of $200 annually to inspect and maintain their sprinkler systems. In Boston and Harrisburg, the owners have contracted with services to remotely monitor flow-activated alarms, at an annual cost of $120 and $60, respectively.

While the rehabilitated condition of the buildings may cause a reassessment and subsequently higher tax bill, none of the owners could estimate what, if any, property tax increase was directly attributable to the presence of the fire sprinkler systems. The federal grants that paid for the installations precluded any significant interest or financing charges for these systems. It will not be possible to assess water damage expenses in these buildings until such circumstances arise.

ECONOMIC BENEFITS TO BUILDING OWNERS INSTALLING FIRE SPRINKLER SYSTEMS

The principal economic benefits from any residential fire protection strategy result from the potential reductions in losses from fires and from reduction in the underlying probability of fire. The major categories of economic benefits are, reduced property insurance premiums, reduced property damage costs, construction variances accompanying a sprinkler system, and increased marketability of units equipped with fire sprinklers.

Property Insurance Discount

As reported in Table III, the owners of the buildings in four of the jurisdictions benefited from savings on property insurance premiums ranging from zero to 45 percent. In Austin, the Texas State Board of Insurance does not currently recognize NFPA-13D systems, thus allows rate discounts only *on NFPA-13* sprinkler systems. In some cases updated policies on the rehabilitated buildings were less expensive than the original policy; these insurance premium reductions were due, in part, to the improved general conditions of the dwelling, and in part to the installation of fire sprinklers.

Table III. Property Insurance Information As Reported By Building Owners And Insurance Agents.

FIRE SPRINKLERS AND PROPERTY INSURANCE

	Austin1	Austin2	Boston	Harrisburg	Pr. Geo. County	St. Louis
DISCOUNT	0%	0%	45%	35%	5%	20%
REPLACEMENT	100%	100%	100%	100%	100%	65 - 70%
COVERAGE DEDUCTIBLE	$250	$250	$1,000	$500	$250	$500

SOURCE : Building Owner and/or Insurance Company Representative.

Rate decisions in the insurance industry are guided by an advisory organization, the Insurance Services Office (ISO). IS0 has recommended that companies offer discounts of up to 10 percent on fire insurance policies for rental structures that have “partial” sprinkler coverage and up to 20 percent for buildings that have “full” coverage. Insurance companies

are free to offer higher or lower discounts with regulatory approval. The discount on any individual policy is determined on a case-by-case basis, particularly for large policies, and is dependent on the evaluation of an underwriter. An underwriter bases actual rates on the reliability, maintainability, and expected performance of a sprinkler system, in addition to standard risk factors such as the local community fire protection rating and distance to the nearest fire hydrant and fire station.

Reduced Property Damage Costs

Many fire insurance policies provide only partial coverage. That is, an owner may get only partial reimbursement because of a deductibles, low policy limits, or the type of coverage (e.g., full replacement cost or less). An owner with only partial coverage will benefit from any system that reduces the likelihood of property damage from fire. Table III shows that in four of the jurisdictions the building insurance policies cover full replacement value. The exception was St. Louis where the insurance policy only covers the value of the *rehabilitation*, estimated to be 65 to 70 percent of the replacement cost of the building. Deductibles are also given in Table III for the reader's information.

Reductions in the *probability* of major fire can also be attributed to the fire sprinkler system. Although this can be counted as an economic benefit to the building owners, its value is uncertain and difficult to predict.

Construction Alternatives

Only in St. Louis were construction variances granted as a result of the installation of fire sprinklers. St. Louis uses the Building Officials and Code Administrators (BOCA) model building code, which requires emergency egress from the third floor of three-story buildings as well as 60-minute fire wall construction in stairways. For the sprinklered building at 2102 Lafayette Avenue, the building commissioner waived both requirements. The Research Center staff has estimated that $4,650 was saved by these exceptions: $4,500 by omitting the egress, and $150 by the reduction in stairwell wall rating.

Improved Marketability of Units With Sprinklers

The fact that occupants of units with fire sprinklers are exposed to a reduced probability of death or injury from fire may be a marketable benefit. Statistics on fire death experience in the five jurisdictions are provided in Table IV. They show that fire losses tend to be disproportionately higher in neighborhoods with high percentages of low-income residents when compared to the percentage of the population that actually reside in those neighborhoods. In four of the five communities, the population residing in those neighborhoods suggest an adequate market base for "selling" the "reduced probability" feature. Some renters may qualify for more tangible benefits through reductions in their own personal property insurance, or "renter's insurance," due to the presence of fire sprinklers in their unit.

Table IV. Fire Statistics in Project Communities.

Site	Percentage of Fire Fatalities* in Low-Income Neighborhood	Percentage of Total Population Residing in Low-Inc Neighborhood
Austin	39	6
Boston	43	32
Harrisburg	65	25
Prince George's County	66	40
St. Louis	66	55

*Time periods covered differ by site.

SOURCE: Fire fatalities from fire departments. Population from housing and community development departments.

The benefit of reduced probability of death or injury to tenants resulting from presence of fire sprinklers may accrue to building owners through increases in rental income. The incremental increase in rents that can be justified by the sprinkler system was not studied in this project and is not clearly known.

Also, the fact that the buildings participating in this project contained fire sprinklers may have shortened the time the units remained vacant, to the extent that prospective tenants may look favorably upon enhanced fire safety when choosing among similarly priced units.

Tenants may express a significant willingness-to-pay for improved fire safety and favorably compare the value of their housing dollars (or vouchers) spent on units with sprinklers versus units without them. Although the owners in Prince George's County advertised the presence of fire sprinklers along with their more standard advertising strategies, none of the owners participating in this project could report that the sprinklers had a clear effect on the length of vacancies or rent levels.

Within the five sites, building owners often cited the inherent need to keep rents down in low-income neighborhoods. Further, they argued that the presumed marketing advantages gained from the fire sprinkler system, those discussed above, were largely intangible and could not be reliably predicted. Thus, the fire sprinklers represented an additional payout, with an uncertain rate of return.

PROBLEMS & RECOMMENDED SOLUTIONS

Based on the experiences and knowledge gained in the course of the project, the Research Center observed several recurring technical and regulatory barriers that impeded the installation of RFS in these rehabilitation projects. Below is a summary of the problems encountered with recommended approaches to alleviating those barriers.

- ***Problem: Lack of Interdepartmental Cooperation, and Framework for*** RFS ***Implementation.*** The installation of fire sprinklers in HUD-funded rehabilitations typically involves at least three municipal authorities: the community development, fire, and water departments. All of these agencies have a role in planning the installation of fire sprinklers in federally subsidized rehabilitation projects. Sometimes nonprofit construction organizations are also involved. A lack of communication and cooperation between these departments in some jurisdictions impeded the timely and economical installation of RFS in these buildings.

  Recommendation: These departments should review and understand the appropriate procedures for installation of RFS in rehabilitation projects in their jurisdictions. Opportunities should be made available for city employees to know and understand the personnel and procedures of other city departments that are involved in RFS installation. Initiatives by local fire departments would be most appropriate in this regard. This project, for example, was instrumental in developing the needed relationships between the departments in these five sites. Hence, in future installations the process will be more familiar to those involved and should move more smoothly.

- ***Problem: Unpredictable & Inconsistent Insurance Benefits.*** In many cases, reductions in insurance premiums are the enticement to building owners that overrides all others. Currently, premium reductions vary greatly from state to state and are largely inconsistent. As we have seen, some states still do not recognize NFPA-13D systems for fire rating credit. Building owners in these jurisdictions have little or no incentive for installing RFS.

Recommendation. To enhance the benefit of RFS to building owners, a more unified system of insurance discounts for sprinklered buildings is suggested. This would allow building owners to predict the cash benefit to them that may accrue.

- ***Problem: Lack of Competition in RFS Installation Work*** The affordability of RFS in residential dwellings depends on reasonable installation costs. The fire sprinkler industry is currently dominated by contractors that specialize in relatively large NFPA-13 commercial systems. Either the profit margins in small NFPA-13D and 13R residential systems are not adequate to entice the large operations into the residential market; or, their overhead costs do not allow these firms to deliver the small jobs at reasonable prices.

  Recommendation: (Less Dependence on Commercial NFPA-13 Contractors). Licensed plumbers possess the mechanical skills for installing NFPA-13D and 13R systems but lack design expertise. Plumbers should be made aware of the business expansion opportunities available in RFS installations. And, municipal authorities should develop training programs to bring plumbers into the RFS arena, or work with sponsors who have already developed programs. We have seen activity in this direction, particularly in the state of Florida where a class of license has been adopted for 13-D installers.

- ***Problem: Barriers in Providing Water Service.*** In smaller buildings typical of those participating in this project, the water service provided was based on sizing guidelines that are now outdated, even for ordinary modern sanitary requirements. Installation of water based fire suppression systems required additional connections to the water main, or upsizing of the existing connection. This process was further complicated by the local water department policies and fees that overlay those hook-ups. Water department policies as they pertain to new taps and upgraded service can sometimes render a residential sprinkler system uneconomical, particularly in smaller buildings where those costs represent a larger proportion of the bottom line.

  Recommendation: Local water departments in some jurisdictions need to reconsider the impact of policy and fee structures on the retrofitting of RFS in residential

buildings occupied by high-risk populations. However, it is the local fire departments that must initiate that activity or renegotiate those policies, and set an appropriate course of action in their jurisdiction. Some water departments expressed a willingness to do so, but were awaiting opportunities to formally study proposals.

- ***Problem: Unbalanced Priorities.*** Within some fire departments, there are policies based on the assumption that some protection in domestic dwellings is not better than none. This policy can intimidate many building owners that may otherwise have considered adding fire suppression systems to their rehabilitation plans. The use of plastics in residential systems, for example, is still not recognized by some jurisdictions. Again, the policies of insurance regulators may also be a contributing factor.

  Recommendation: Fire officials and local governments should consider a balance between the affordability concerns of building owners and the fire protection concerns of their communities when legislating sprinkler standards. This is particularly relevant in the rehabilitation of low-income housing where profits from rents may already be marginal, and building owners lack sufficient incentive. As the costs of these systems are allowed to go down, the reliance on financial incentives for cost effectiveness will diminish. But, when the major cost drivers remain inflated, those incentives will continue to be necessary in order for RFS to be a voluntarily addition to rehabilitation work plans.

COMMUNITY: Austin, Texas

CONTACT:
Steve Cook
Austin Fire Department
517 S. Pleasant Valley
Austin, TX 78741
(512) 448-2455

Laurie Born
Housing Division
Housing & Community Services Department
City of Austin
1622 E. Riverside Drive
Austin, TX 78767
(512) 442-7200

BUILDING LOCATIONS: 2601 Sol Wilson Avenue,
3501 Pennsylvania Avenue
Austin, TX

BUILDING OWNER:
Mike Leff
8403 Research Blvd.
Austin, TX
(512) 837-6350

TENANTS: Low and moderate-income families.

BUILDING DESCRIPTION: Two duplexes, wood frame construction, 1,280 and 1,360 square feet, circa 1960.

SPRINKLER SYSTEM: NFPA 13D Residential Sprinkler System.

SYSTEM DESIGN & INSTALLATION CONTRACTOR:
Sandberg Fire Protection of Texas, Inc.
201 Industrial Boulevard
Austin, TX 78745
Contact: Mike Parker

STATUS: System operational, rehabilitation complete, buildings reoccupied.

COMMUNITY: Boston, Massachusetts

CONTACT:
Chief Paul Cook
Boston Fire Department
115 Southhampton Street
Boston, MA 02118
(617) 442-8000

Barry Berman
Development Specialist
Public Facilities Dept
City of Boston
15 Beacon Street,
9th Floor
Boston, MA 02108
(617) 720-4300

BUILDING LOCATION:
777-779 Huntington Ave
Mission Hill
Boston, MA

BLDG. OWNER & DEVELOPER:
Hugh Kelly
KVC Associates
1 Fenwood Road
Boston, MA 02115
(617) 731-0165

TENANTS: Low and moderate-income families.

BUILDING DESCRIPT.: 22-unit, masonry building, three-stories with commercial space on first floor. 21,600 square feet, circa 1900.

SPRINKLER SYSTEM: Modified NFPA 13D system, four sprinkler head design with polybutylene lines. One inlet control manifold for each of the two sections of the building.

SYSTEM DESIGN & INSTALL.:
Fire Protection Plus, Inc.
33 Thelma Road
Framingham, MA 01701
Contact: Tom Rinoldo
(617) 8750722

STATUS: System operational, rehabilitation completed, building reoccupied.

COMMUNITY: Harrisburg, Pennsylvania

CONTACT:

Donald Konkle
Harrisburg Fire Dept
123 Walnut Street
Harrisburg, PA 17101
(717) 255-6464

Eric Hinderliter
Dept of Community and Economic Development
10 N. Market Square
Harrisburg, PA 17101
(717) 255-6480

BUILDING LOCATION: 1317-19 Derry Street
Allison Hill
Harrisburg, PA

BUILDING OWNER & DEVELOPER:

Richard and Michael Kushner
Inner City Developers, Inc.
919 Susqueharma Street
Harrisburg, PA 17102
(717) 236-6620

TENANTS: Low and moderate-income families.

BUILDING DESCRIPT.: Three-story masonry building, wood-frame interior, six apartments, first floor commercial. 7,100 square feet, circa 1900.

SPRINKLER SYSTEM: Modified NFPA 13D.

SYSTEM DESIGN: NAHB National Research Center.

SYSTEM **INSTALL.:** Building owner - rehabilitation contractor.

STATUS: System installed, building undergoing rehabilitation.

COMMUNITY: Prince George's County, Maryland

CONTACT:
David M. Banwarth, P.E.
Division Manager
Engineering Division
Bureau of Fire Prevention
and Investigations
14741 Gov. Oden Bowie Drive
Room 1155
Upper Marlboro, MD 20772
(301) 952-5538

Emelda Johnson-Heller
and Leroy Brown
Department of Housing
Community Development
Landover Mall East
Suite 300
Landover, MD 20785
(301) 386-5073

BUILDING LOCATION:
The Lodge Apartments
5345-53 Sheriff Road
Capitol Heights, MD

BUILDING OWNER:
Wayne A. Bowie
W.A. Bowie & Sons, Inc.
4700 Webster Street
Bladensburg, MD 20710
(301) 779-5666

TENANTS: Low and moderate-income families.

BUILDING DESCRIPT.: 15-unit, three-story, masonry building; 16,660 square feet, circa 1965.

SPRINKLER SYSTEM: Modified NFPA 13D system, 2-head design.

SPRINKLER DESIGN: NAHB National Research Center.

SPRINKLER INSTALL.:
Livingston Fire Protection
5150 Lawrence Place
Hyattsville, MD 20781
Contact: Frank Livingston
(301) 7794466

STATUS: System operational, building undergoing rehabilitation, partially reoccupied.

COMMUNITY: St. Louis, Missouri

CONTACT:

Chief George F. Jenkerson
St. Louis Fire Department
City Hall, Room 418
1200 Market Street (at Tucker)
St. Louis, MO 63103
(314) 622-4194

Don Bollinger
Community Development Agency
City of St. Louis
411 N. Tenth Street
St. Louis, MO 63101
(314) 622-3400

BUILDING LOCATION:

2102 Lafayette Ave.
Lafayette Park
St. Louis, MO

BUILDING OWNER & DEVELOPER:

Stephen E. Bayer
The Pride Organization
3606 Botanical
St. Louis, MO 63110
(314) 776-2400

TENANTS: Moderate income families.

BUILDING DESCRIPTION: Masonry, three stories plus basement, 4-units, 8,000 square feet, circa 1880-1890.

SPRINKLER SYSTEM: Modified NFPA 13D.

SYSTEM DESIGN & INSTALLATION CONTRACTOR:

Grinnell Fire Protection Systems Company
8200 Exchange Way
St. Louis, MO 63144
Contact: David Gagan
(314) 968-4950

STATUS: System operational, rehabilitation complete, building reoccupied.

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