RESIDENTIAL FIRE SPRINKLERS RETROFIT DEMONSTRATION PROJECT

Final Report

Phase II:
Single-Family
Structures
Case Studies

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNITED STATES FIRE ADMINISTRATION

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CASE STUDIES

RESIDENTIAL FIRE SPRINKLERS RETROFIT TECHNICAL ASSISTANCE PROJECT

Phase II: Single-Family Structures

Cooperative Agreement No. HA- 12963

Submitted to:

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and

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EXECUTIVE SUMMARY

The United States Fire Administration (USFA) funded the design and installation of quick-response residential fire sprinkler systems in single-family homes undergoing rehabilitation in Denver, Colorado, and five jurisdictions in the state of Florida; and a multifamily dwelling in Seattle, Washington. This was the second phase of a two-phase project, and like the first phase, the USFA funding was in conjunction with money for housing rehabilitation provided by the U.S. Department of Housing and Urban Development (HUD). As in Phase I, technical assistance to the sites provided by the NAHB National Research Center was funded by HUD.

Major goals of Phase II of this technical assistance project were:

- Addressing the site-specific technical, regulatory, and administrative barriers to residential fire sprinkler installation in single-family homes undergoing rehabilitation;
- Recognizing how local standards and practices might be modified to facilitate installation of residential fire sprinklers during single-family rehabilitations;
- Using the latest available residential fire sprinkler technology; and
- Performing the work and recording the project experiences in a manner that would best accommodate the transfer of usable information to other states and localities across the country.

The major considerations for design of the sprinkler systems were sprinkler plumbing, coverage and location of sprinkler heads, and adequacy of existing water service.

Total square foot costs for installation and design ranged from a low of $1.42, to a high of $8.06, with an average cost per square foot of $1.98. Costs were pushed upward in some cases by the unusual shape of sprinklered areas, a lack of interest in small residential projects leading to non-competitive costs, upgrading water service, and a special pump/reservoir necessary at a house not connected to a public water supply. Conversely, costs were lowered in some cases by coordination among a sprinkler association and municipal officials enabling minimum planning and review effort.

In all of the single-family cases the NFPA 13D standard was used to guide design of the sprinkler systems; in the multifamily system NFPA 13D and NFPA 13 were used. (NFPA 13R was not available at the time). The system in the multifamily dwelling consists of copper pipe, and in all other cases CPVC was used. As in Phase I, local fire officials decided on use of pipe, adequacy of water service, location of heads, and other technical issues.

All of the single-family homes are owner-occupied and thus the owners benefitted from the sprinkler systems due to increased safety. None of the owners however, received a discount on their property insurance. The owners of the multifamily building (non-occupants) reported a 50 percent insurance discount and were allowed to rent the top floor, previously deemed uninhabitable by the local fire department. The annual rent is $4,800.

Each participating jurisdiction conducted a public outreach program to publicize the project specifically and fire safety in general. Outreach activities included a model or “doll” house depicting fire safety systems that is brought to public gathering spots, a public service announcement on fire sprinklers, a statewide educational seminar campaign, and a video for local cable television covering the project and fire safety.

CHAPTER 1 INTRODUCTION

Residential fire safety is the primary concern of the United States Fire Administration (USFA), an operating division of the Federal Emergency Management Agency (FEMA). USFA recognizes that opportunities exist to increase the fire safety of high-risk, low- and moderate-income dwellings, at reasonable cost by the installation of quick-response residential fire sprinklers during building rehabilitations. The *Residential Fire Sprinklers Retroflt* Technical Assistance Project was initiated to explore and take advantage of these opportunities.

During Phase I, USFA funded an effort to have residential fire sprinklers installed in high-risk multifamily buildings that were undergoing rehabilitation with U. S. Department of Housing and Urban Development (HUD) Community Development Block Grant or Rental Rehabilitation Program funds. This was a successful effort, and Case Studies for the Phase I sites are available from the USFA. As a follow-up, Phase II was designed to target single-family or single-family conversions being rehabilitated with HUD funds. The Phase II technical assistance recipients were Denver, Colorado: Seattle, Washington: and the states of Ohio and Florida for small cities within those states.

Funding for this project came from USFA appropriations, which expressed a Congressional intent that they focus on fire safety among "high-risk" populations. USFA funds were transferred to HUD, so that HUD could extend an existing cooperative agreement with the NAHB National Research Center (Research Center) to provide technical assistance to the selected sites. In addition to the technical assistance funding, USFA provided a grant of approximately $20,000 to each of the four recipients to cover the actual material and labor costs for the sprinkler installations.

Major goals of Phase II of this technical assistance project were to develop the methodology for enhancing the fire safety of high-risk single-family dwellings undergoing rehabilitation: and to make possible the transfer of experiences and lessons learned to other local housing administrators and communities. In practice, these goals were accomplished by meeting the following objectives:

- Addressing the site-specific technical, regulatory, and administrative barriers to residential fire sprinkler installation in single-family homes undergoing rehabilitation:
- Recognizing how local standards and practices might be modified to facilitate installation of residential fire sprinklers during single-family rehabilitations:
- Using the latest available residential fire sprinkler technology; and
- Performing the work and recording the project experiences in a manner that would best accommodate the transfer of usable information to other states and localities across the country.

Statistics have shown low-income families to be at a disproportionately high risk of death or injury from fire, as are the elderly, the very young, and the physically immobile. Each recipient city has a sizeable proportion of low-income population.

This project began in each jurisdiction with selection of a building that met the criteria concerning occupants and that was imminently scheduled for substantial rehabilitation. Design of the sprinkler system began after the building was selected and the owner(s) agreed to participate in the sprinkler project.

Standards for sprinkler design, installation, and maintenance have been developed by the National Fire Protection Association (NFPA) and are known as NFPA 13 (1987) for large buildings, NFPA 13D (1987) for one- and two-family residences and mobile homes, and NFPA 13R (1989) for residential structures up to four stories high. The NFPA 13D standard was used at all sites in the second phase of the fire sprinkler project.

NFPA 13 was developed for property protection as well as for life safety and usually applies to large buildings. NFPA 13D was developed primarily for life safely and is used for one- and two-family residential buildings and mobile homes. NFPA 13R is also focused primarily on life safety. Unlike in some 13 systems, all 13D and 13R systems use quick-response heads designed to ensure life safety over property protection. Quick-response heads (all residential) are designed to control incipient fires and provide additional time for occupants to escape. One philosophy behind NFPA 13D is provision of 10 minutes of escape time. The more complex NFPA 13 systems require extra connections and control mechanisms, including flow alarms and external water connections and higher water pressure necessary to cover larger areas. In addition, NFPA 13 delineates many technical variations regarding numerous types of

occupancies, building materials, and levels of hazard. The extensive technical requirements of a 13 system make it more expensive than a 13D or a 13R system.

Principal considerations in the sprinkler system design and installation process included:

- interpretation and application of NFPA sprinkler standards in rehabilitated dwellings as they pertain to hardware (e.g.. pipe and fittings), external fire department connections, and placement of sprinkler heads, including sprinklering non-living spaces:
- Plan review, inspection, and testing requirements and procedures:
- water service connections, metering, fees, and backflow prevention; adequacy of existing water service in satisfying hydraulic requirements of residential fire sprinkler systems; and
- licensure requirements for sprinkler designers and installers.

These questions were resolved by relevant authorities during design and installation of the system and are discussed throughout this report. Fire departments, water departments, community and economic development agencies, and building commissioners or building inspectors provided the necessary requirements and guidance.

The public administration perspective regarding subsidized rehabilitation sprinkler installation requires innovative coordination. The agencies involved in fire sprinkler installation ordinarily interact only to enforce codes, or not at all.

Evaluation of a fire safety system must also consider costs and benefits. Total cost for design and installation of the fire sprinkler systems are presented in the individual chapters that follow. Although there are not enough data to perform a formal cost/benefit analysis, specific benefits are discussed, including life-safely and reduction in fire insurance premiums, increased rentable space, and other construction alternatives.

THE CASE STUDY APPROACH

These case studies investigate the feasibility of installation of residential fire sprinkler systems in single-family houses undergoing rehabilitation and document the costs of fire sprinkler installation. The information is offered as a learning tool to help home builders, state and local officials, and others concerned about residential fire safety evaluate innovations in fire safety systems and opportunities afforded during rehabilitation to retrofit residences with sprinklers. The case studies outline the experiences of those involved in design and installation of the fire sprinklers and discusses specific project characteristics and history. At the end of each chapter is a description of the population, income, housing, and residential production and rehabilitation programs in the subject community.

FIRE SPRINKLER SYSTEM DESIGN AND INSTALLATION

Specific design criteria for residential sprinkler systems include:

- adequacy of existing water service;
- coverage and location of sprinkler heads:
- response time/activation of sprinkler heads; and
- sprinkler system plumbing.

Each of these items is addressed by NFPA standards and sometimes by local or other building codes enforced in each community. A general discussion of the technical considerations is included in this section. The following chapters discuss the technical considerations of fire sprinkler systems as they pertain to the four participating jurisdictions.

Water Service

The water system in each of the subject buildings was evaluated for sufficient pressure and flow to operate a sprinkler system. In making this determination, the project team evaluated the size of the existing water service connection to the public water supply or to a well, supply pressure at the connection, building height, anticipated pressure losses within the system, and the maximum number of heads for which simultaneous flow is required.

According to NFPA 13D (Section 4- 1. 1), the flow rate at a sprinkler head in a protected area requiring only one head must be no less than 18 gallons per minute (CPM). In compartments requiring two heads, each head must deliver no less than 13 GPM simultaneously. Engineering design protocol is that if these requirements are met at the sprinkler head(s) that calculations indicate will have the lowest flow rate (usually the

farthest heads), it is generally assumed that they will be met or exceeded throughout the system. Therefore water delivery design must include pressure and flow-rate calculations at the sprinkler head most hydraulically remote from the water source and, in a "two-head" (or a "four-head') system, at the two (or four) heads located in the most hydraulically remote compartment (room) large enough to require two (or four) heads. Two-head designs are more common for residential systems because rooms large enough to require four sprinkler heads are rarely encountered. Furthermore, four-head systems are required by NFPA 13 but not by NFPA 13D.

Coverage and Location of Sprinkler Heads

One step in system design is to calculate the number and location of sprinkler heads. This calculation is primarily related to the square footage of the rooms and areas to be sprinklered. although the geometry or shape of each area is also a factor. NFPA 13D (Section 4-1 4.1) states the requirement for the maximum area covered by a single head to be 144 square feet. Spacing requirements found in NFPA 13D (Section 4-1 4.2). call for pendent heads to be one to four inches (4"-6" for sidewalls) from the ceiling. 'The maximum distance between sprinklers shall not exceed 12 feet on or between pipelines and the maximum distance to a wall or partition shall not exceed 6 feet. The minimum distance between sprinklers within a compartment shall be 8 feet." NFPA 13D requires installation of sprinklers in all areas with the following exceptions noted in Section 4-6:

- bathrooms not exceeding 55 square feet with noncombustible fixtures;
- closets where the least dimension does not exceed three feet (0.9 m.) and area does not exceed 24 square feet and the walls and ceiling are surfaced with noncombustible materials;
- open attached porches. garages, carports, and similar structures;
- attics and crawlspaces not used or intended for living purposes or storage: and
- entrance foyers that are not the only means of egress.

Excepting the areas listed above is generally viewed as posing a minimal life safety risk, and including sprinkler heads in those areas would likely add significantly to the cost of a residential fire sprinkler system.

Response Time/Activation of Sprinkler Heads

Occupant response time is a crucial factor in fire safety. Most deaths from residential fires result from inhalation of smoke or toxic gases such as carbon monoxide that can spread faster than flames. Sleeping or mobility-impaired persons in particular can be asphyxiated before they can escape. To protect occupants under conditions in which smoke detectors may be insufficient, sprinklers must activate early in a fire's sequence of events. One philosophy behind NFPA 13D is to provide fire control for ten minutes in the room of fire origin to protect occupants during their escape.

Sprinkler head activation is initiated in most sprinkler heads through the use of a fusible link, a temperature-sensitive mechanism usually made of a metal. However, other types exist and the exact method employed varies among manufacturers. When the room temperature reaches the sprinkler head operating temperature, the link melts, dissolves. breaks, or otherwise disengages, releasing the water closure and allowing water to flow. Each head operates independently of all others. To avoid accidental discharge. heads are generally set to discharge at no less than a maximum ambient temperature plus 35°F, generally between 135°F and 170°F in a residential environment.

SPRINKLER SYSTEM PLUMBING

During system design, the project design team selected pipe and fitting material. Historically, sprinkler systems were fabricated of copper or steel piping materials. In recent years, residential sprinkler designs have increasingly specified plastic pipe and fittings in the sprinkler systems. Plastic has become the preferred material in 13D systems due to both lower material and installation costs made possible by its flexibility and ease of assembly. Two plastic materials are available for use in sprinkler systems. They are polybutylene and chlorinated polyvinyl chloride (CPVC). CPVC is fire rated allowing it to be installed uncovered in protected compartments; Its joints are solvent-welded together using an adhesive primer and a compound made, in part, of liquified CPVC that dries to help form a single piece of pipe. By contrast, polybutylene must be covered by material with a 30-minute fire resistive rating and its joints are formed by heat welding or with clamps and a crimping tool. Steel and copper piping are still

used in many commercial and multifamily fire sprinkler applications.

FIRE SPRINKLER SYSTEM COSTS

Specific costs for each sprinkler system installed during this phase of the project are presented in the chapters devoted to individual sites. Costs per square foot ranged from a high of $3.72 to a low of $1.50. with an average cost per square foot of $1.98. There were several major factors driving up the final costs of each system. The unusual configuration of one building with numerous "nooks and crannies" required extra pipe and fittings to provide adequate coverage. In addition, the costs of upsizing water service added significant cost to some of the systems.

Operation and Maintenance Costs

Fire sprinkler systems are subject to various costs whether or not a fire occurs in a building equipped with them. Costs may include water fees, inspection, 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 where a loan is involved. Further, in the event of a fire large enough to cause sprinkler activation (or false activation). there will be costs for replacement of heads, water service, and potentially other repair and maintenance costs. There may also be water damage to the building or its contents.

ECONOMIC BENEFITS TO OWNERS OF BUILDINGS WITH FIRE SPRINKLERS

The principal benefits from any residential fire protection strategy are potential reductions in losses from fires and reduction in the underlying probability of fire. The major categories of benefits are improved life safety, reduced insurance premiums, reduced property damage costs, reduced costs of indirect fire losses, and savings due to construction alternatives. This section discusses these benefits in general, while the chapters on each jurisdiction discuss specific benefits to the participating owners of the buildings. National Bureau of Standards Technical Note 1203 (Ruegg and Fuller, 1984) presents a more detailed analysis of the benefits of a hypothetical sprinkler system.

Improved Life Safety

Occupants of units with sprinklers benefit from a reduction in probability of death or injury from fire. Statistics (in each chapter below) showing local fire death experience give an indication of the potential for reduction in fire-related fatalities. As noted above, one philosophy behind NFPA 13D is to provide 10 minutes of fire control to protect occupants during their escape, and when a residential fire sprinkler system is supplied by stored water, NFPA 13D (Section 2-1) states the supply should be sufficient to provide 10 minutes of flow.

Owners (nonoccupants) of sprinklered multifamily buildings ordinarily would benefit from the effect of sprinklers on rental income. Two factors predominantly determine the extent of effect on rental income: economic conditions in the housing market such as vacancy rate and median income of area residents, and regulatory authority by federal, state, or local governments that control rent levels and/or subsidize rental payments.

Property Insurance Discount and Reduced Property Damage Costs

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 8 percent on fire insurance policies covering single-family structures that have "partial" sprinkler coverage and up to 10 percent for buildings that have "full" coverage. Insurance companies are free to offer higher or lower discounts with regulatory approval. The discount on any particular 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 fire sprinkler system, in addition to standard risk factors such as the local community fire protection rating and distances to the nearest fire hydrant and fire station.

Many fire insurance policies provide only "partial coverage." An owner may not be reimbursed for some of the costs of property destroyed by a fire, due to a deductibility, a low policy limit, or type of coverage (replacement cost or depreciated cost basis). An owner in this situation will benefit from any system that reduces the likelihood of property damage from fire. In addition, several types of damage and costs from a fire will not be covered by insurance. Examples include demolition of remaining property in preparation of construction, security of remaining property, and special administrative procedures in response to loss of property. Further, tenants may have insurance policies that protect against losses in their units, and reduced probability of fire may benefit those with such policies.

Construction Alternatives

Many jurisdictions enforce local building codes as well as regional or national codes. Life-safety codes require a variety of fire safety measures and systems such as emergency egress from upper floors of multifamily buildings, minimum window sizes, and use of wall materials with a prescribed fire resistive rating. However, in recognition of protection provided by fire sprinklers, local building officials often waive such requirements, thus reducing some costs of rehabilitating or owning a building.

LOCAL FIRE EXPERIENCE

High-risk populations include the elderly, the very young, and people with limited ability to move without assistance. In Denver, 12.6 percent of the population is 65 years old or older and 6.7 percent is 5 years old or younger. Further, physical handicaps limit the mobility of 1.2 percent of the population. To respond to the fire protection needs of the city, the Denver Fire Department maintains the forces listed in Table 2-1.

TABLE 2-1
DENVER FIRE DEPARTMENT

Stations (engine and ladder)	27
(average coverage of 5.7 square miles per station)	
Engine Companies	27
Ladder Truck Companies	15
Rescue/Hazardous Material Stations	2
Firefighters (Professional)	831
Firefighters on duty during each of 3 shifts	242
Fire Chiefs/Assistant Chiefs'	31
Fire Districts	6
(average of 26 square miles per district)	
Fire Hydrants	11,963

Source: Denver Fire Department, Bureau of Fire Prevention

It is likely that a city as large as Denver will experience residential fire fatalities during a given year and that a disproportionate share of victims will be either elderly or very young. Although the over-65 and under-five population combined represents only 19.3 percent of Denver's population, Table 2-2 shows that these groups accounted for approximately 37 percent of the fire fatalities during a lo-year period. Further, fire deaths are more likely to occur in low-income neighborhoods, defined as neighborhoods where property values are lower than average and a higher than average proportion of people live in poverty, The Bureau of Fire Prevention reports that of the 91 fatalities presented in Table 2-2, 60 percent occurred in low-income neighborhoods.

TABLE 2-2
FIRE FATALITIES
DENVER 1977-87

YEAR	NO. OF CIVILIAN FIRE DEATHS (RESI)	65 & OLDER OR 5 & YOUNGER #	%
1979	13	5	38
1980	10	2	20
1961	16	4	25
1982	7	4	57
1983	11	4	36
1964	5	2	40
1985	6	3	50
1986	5	2	40
1987	8	4	50
1986	10	4	40
Total	91	34	37

Source: Denver Fire Department, Bureau of Fire Prevention.

PROJECT INITIATION

The NAHB National Research Center's (Research Center) selection of Denver, verified in a letter from Mayor Federico Pena, led to initiation of the Community Development Agency's (CDA) and the Denver Fire Department's (DFD) participation in the technical assistance project. The Research Center notified CDA of the availability of federal money to increase fire safety among urban low-income populations, though the funding sources (U.S. Fire Administration [USFA] and the U.S. Department of Housing and Urban Development [HUD)) required the funds to be used in conjunction with other Community Development Block Grant (CDBG) funds allocated to rehabilitation of low-income housing. Therefore, the Research Center informed CDA of the agency's responsibility to select two or more houses that were imminently scheduled to undergo rehabilitation using CDBG funds and were inhabited by low-income persons. Further, CDA staff contacted the Denver Water Department (DWD). They also identified several tentative sites for the program.

At an orientation meeting in January 1988, Research Center staff met with Tom McManus of the DFD and Ernest Hughes of the CDA.

Research Center staff outlined the project and ensuing discussion highlighted potential problems, including possible water tap fees assessed by the DWD for sprinkler installation.

Even though the cost of a water tap could render the project infeasible, the parties agreed that the Denver project should in part focus on development of a new water policy concerning residential fire sprinklers, Any new policy would have to balance citywide water policies with affordability concerns. Mr. McManus, stating that the fire department was in favor of the use of sprinkler systems in residential buildings, noted that the department would encourage their use.

Soon after the initiation meeting, staff from the Research Center met in Denver with staff from CDA and DFD as well as the rehabilitation director for a local nonprofit housing advocacy group. The Denver City Council mandated that a nonprofit group undertake sprinkler installation as part of their ongoing housing rehabilitation. Part of the meeting was to plan for a meeting later that day with the DWD and the Denver Building Department. As mentioned, water fees were a paramount issue. In general, the DWD charges the following system development charge for all new taps:

3/4 inch line	$ 2,730
1 " "	$ 5,460
1.5 " "	$10,920
2 "	$ 1,840

It was agreed at the meeting with the DWD that a possible waiver of the fee would be considered after submission of sprinkler system plans. It was stated by the DWD that a waiver would be based on the technical assistance nature of the project and would not necessarily be available to other building owners considering installation of fire sprinklers.

Soon after the second meeting, CDA began the selection process to identify houses that met the stated criteria. After review of several potential sites, CDA chose four single-family detached houses in northeast Denver located at:

2755 Gaylord Street
3145 Gaylord Street
3713 Gaylord Street
3774 Gilpin Street

2755 Gaylord Street.

3145 Gaylord Street

3713 Gaylord Street.

3774 Gilpin Street.

Living space in each house is approximately 1,000 square feet. CDA contacted by letter the Denver Urban Renewal Authority (DURA), a nonprofit organization with a large portfolio of rehabilitation projects, and informed DURA of the project goals. Soon after being invited to participate, DURA agreed to join the project.

The letter from CDA stated its willingness to reimburse DURA for the costs of installing a fire sprinkler system, including design and site work. Funds for reimbursement would come from a grant to CDA from USFA, contingent on execution of a written agreement between CDA and DURA. The grant instrument from The Federal Emergency Management Agency (FEMA) specified that costs were to be in accordance with the budget approved by USFA, with fire sprinkler installation costing up to $12,000 and site work up to $5,000. Site work included water main taps, water lines, and trenching. DURA agreed to pay any additional sprinkler installation costs above the budgeted amount. In addition, the fire department and CDA agreed to a USFA request to conduct a public outreach program for the project, budgeted at $5,000. Grant provisions disallowed transfer of funds in excess of 5 percent between cost categories without approval from the project officer at FEMA.

All participants agreed to communicate regularly during the design phase, with meetings scheduled in Denver as necessary and, if possible, in conjunction with site visits by Research Center personnel. The parties also agreed that telephone conversations and/or written communication would be necessary to secure input regarding system design. Photographs of the rehabilitation of the buildings would be taken by the Research Center, including installation of the sprinkler systems together with "before and after" views of construction.

After informing all participants of their roles and the overall goals of the program, the Research Center began the design phase of the sprinkler system.

FIRE SPRINKLER SYSTEM DESIGN AND COSTS

The CDA distributed a request for proposals throughout the Denver area, in particular to members of the Denver Fire Sprinkler Association. As part of its procurement process, the CDA held a prebid meeting (including building walk-throughs) for contractors considering bidding. Only three companies were represented at the meeting, indicating a low level of interest in the job. That indication was substantiated when only one company bid on the project. Further, the bids for the sprinkler installations in the four small single-family houses were significantly higher than expected, leading the project team to conclude that there were no local contractors Interested in the project. The size of the bid, nearly $9 per square foot, was not considered reasonable by the project team. The bids were as follows:

2755 Gaylord Street	$ 9,012
3713 Gaylord Street	$ 8,950
3774 Gilpin Street	$ 9,518
TOTAL	$36,173

During the several months after the Research Center requested justification of the bids, the city of Denver encountered difficulties with new funding for housing rehabilitation, particularly single-family homes. The project team decided to look at other types of residences as a way to move forward with the project, as the funding availability for single-family rehabilitation continued to be in doubt. Several potential sites were identified, including transitional housing for single mothers and a halfway house for persons with mental disabilities. The Del Norte Neighborhood Association, another nonprofit housing organization in Denver, was contacted and agreed to participate in the project. Del Norte identified two buildings they considered most suitable for the project and, after a site visit by staff from the Research Center, the project team agreed that the buildings met the revised criteria for the Denver project.

Attached single-family homes once chosen to replace the detached single-family homes.

Although satisfied with the selection of different buildings, the project team continued to look for ways to include single-family detached houses. Shortly before design was to begin on the Del Norte buildings. the CDA determined there most likely would be funding available in the summer of 1989 for single-family housing rehabilitation. The team decided that the research goals of the project would be better served by selection of detached houses, and based on those goals reconsidered inclusion of the original four houses.

The CDA secured the financing for rehabilitation of two of the four houses, 3145 Gaylord Street and 3713 Gaylord Street, both in northeast Denver (see Figure 2-1). Rehabilitation took four months in late 1989 and early 1990. The DFD located AAA Fire Sprinkler, Inc., a licensed contractor interested in NFPA 13D the sprinkler design and installation. Fire sprinkler installation in each of the two houses took approximately 100 hours of labor. The sprinkler installations were completed in December 1989 and January 1990. The DWD granted an exemption from the tap fee for this project. Currently, the DWD and the Denver City Council are reviewing policy regarding water tap fees and residential fire sprinkler systems. The latest information suggests that the owners of the subject houses will be charged a monthly stand-by fee of one dollar for the dedicated sprinkler tap.

OUTREACH

The DFD videotaped and photographed the sprinkler installation. They plan to use the film for both outreach and education. In addition, the Denver CDA produced promotional materials for residential fire sprinkler systems. The materials are distributed throughout the housing rehabilitation industry.

The DFD routinely conducts educational and outreach activities. The video and the photographs will be useful in those activities. Further, the experience from this project will help the DFD address political issues surrounding water connections for residential fire sprinklers.

COMMUNITY DEVELOPMENT: HOUSING

Upgrading housing conditions in Denver is a priority of the CDA and has led to development of the Housing Assistance Plan (HAP). The city devotes one-third of its combined CDBG and Rental Rehabilitation Program (RRP) funding to housing improvement. Specifically, the city offers five housing development and Improvement programs.

Single-family home rehabilitation loan program

This program offers low-interest loans for single-family housing renovation and repair. Home

3145 GAYLORD STREET

House Size: 1.345 so. ft. Structural Data: Brick frame, one-story with basement

Condition Prior to Rehabilitation: Vacant--in need of major repair

Smoke Detectors: 2 battery-powered

Energy Improvements: New storm windows and Insulation (R-30)

Total Rehabilitation Cost: $33,500 Total RFS Cost: $ 7,355

Sprinkler Contractor: AAA Fire Sprinkler, Inc. (Mr. Pete Froyen)

Number of Heads, Pendent or Sidewall: 12 pendents, 1 sidewall Spare Heads: 3

Head Manufacturer: Reliable Sprinkler Company, Inc.

Placement in Non-required Areas (13D or other): None

Activation Temperature: 165°F Meter: No, water stand-by fee of $1 per month

Water Service: New dedicated one-inch line for sprinkler system

Back-flow Prevention, Check Valves: Single check valve

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoffs: Access to shutoff valve is unlocked External Connections: None

Pressure Gauge, Test Valve: Yes to both

Pipe Material: Interior is CPVC and steel: Underground water connection is copper

Exposed System, Drop Ceilings: None System Tests: Static and flow tests

Installation Chronology: 5 days

Installation Problems: Uncertainty over city code enforcement requirements

Plan Changes: None

Operation Costs: Minimal for inspection and maintenance; $1 per month water stand by fee

Benefits: Improved life safety; protection against uninsured losses

3713 GAYLORD STREET

House Size: 861 sq. ft. Structural Data: Brick frame, one-story with basement

Condition Prior to Rehabilitation: Vacant--in need of major repair

Smoke Detectors: 2 battery-powered

Energy Improvements: New storm windows and insulation (R-30)

Total Rehabilitation Cost: $25,278 Total RFS Cost: $ 6,942

Sprinkler Contractor: AAA Fire Sprinkler, Inc. (Mr. Pete Froyen)

Number of Heads, Pendent or Sidewall: 9 pendents Spare Heads 3

Head Manufacturer: Reliable Sprinkler Company, Inc.

Placement in Non-required Areas (13D or other): None

Activation Temperature: 165°F Meter: No, water standby fee of $1 per month

Water Service: New dedicated one-inch line for sprinkler system

Back-flow Prevention, Check Valves: Single check valve

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoff's: Access to shutoff valve is unlocked External Connections: None

Pressure Gauge, Test Valve: Yes to both

Pipe Material: Interior is CPVC, Underground water connection is copper

Exposed System. Drop Ceilings: None System Tests: Static and flow tests

Installation Chronology: 5 days

Installation Problems: Uncertainty over city code enforcement requirements

Plan Changes: None

Operation Costs: Minimal for inspection and maintenance: $1 per month water standby fee

Benefits: Improved life safety; protection against uninsured losses

3145 GAYLORD STREET, DENVER

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	$ 0	$ 216	$ 216
Mechanical (Includes pipe, fittings, valves, sprinkler heads, flow switches)	$1,610	$4,592	$6,202
lrldtrect costs	$	$ 132	$ 132
Other Fees	$	$ 805	$ 805
TOTAL	**$1,010**	**$6,746**	**$7,956**
cost Per 8q. Ft.			$ 5.47

3713 GAYLORD STREET, DENVER

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	$ 0	$ 216	$ 216
Mechanical (Includes pipe, fittings, valves, sprinkler heads, flow switches)	$1,548	$4,368	$5,916
Indirect costs		$ 132	$ 132
Other Fees			$ 678
TOTAL	**$1,548**	**$4,716**	**$6,942**
Cost Per Sq. Ft.			$ 8.06

FIGURE 2-1

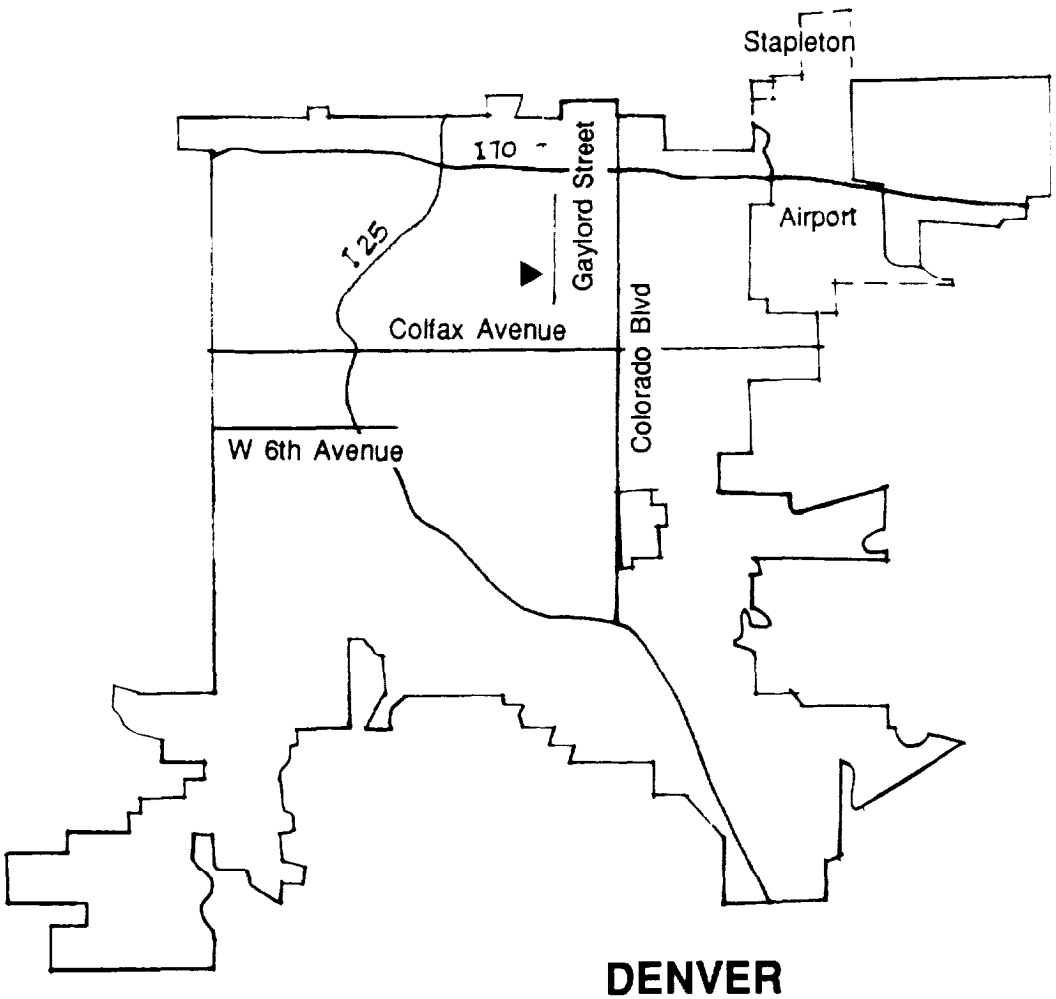


TABLE 2-3
Denver, Colorado
Community Profile

Population (1985 estimate1	505,000
Population below poverty level	13.7%
Population 65 years old and over	12.6%
Population 5 years old and under	6.7%
Population with limited mobility (U.S. Census defined as persons with limited ability to use public transit)	1.2%
Total Housing Units (as of 1985)	227,803
Multifamily (five or more units)	36.6%
Single-Family	38%
Population Density per square mile	$4,728
Population Density per housing unit	2.2%
Housing built prior to 1939	29.4%
Median Price (as of 1985)	$63,700
Median Rental Payment (1989)	$393
Vacancy Rate-overall (as of 1989)	13.1%

owners select eligible contractors for home rehabilitation. Funding for this program works on a revolving basis by recycling federal housing dollars. Loans may have no or little interest due, depending on the income of the recipient. Loans may be made for rehabilitation of homes with values of $60,000 or less.

Emergencv Home Repair

During a recent eight-year period, over $1.3 million have been allocated from the city's Housing and Community Development grant monies for emergency repair, mostly of electric, heating, and plumbing problems. Over 3,500 Denver home owners have benefited from this program.

Boarded-Up Housing Rehabilitation Program

Buildings vacant for at least six months are sold by the city to developers at terms designed to encourage investment in low-income neighborhoods. Upon rehabilitation, the homes are sold to low-income households that make the purchases with financial assistance from the city.

Eastside-Westside band Acquisition

This is a land discretionary fund used to reserve parcels of land in areas stricken with widespread blight. The concept is to ensure future development of housing in areas not yet likely to attract investors and other private sources of renewal monies.

Comprehensive Housing Program

This program offers CDBG funding to developers who are required to use the money to leverage additional funds for housing rehabilitation. The program has produced over 450 new and rehabilitated units in recent years and is looked at in Denver as an effective partnership of public and private housing development interests.

In addition to the above, the city of Denver, through several related agencies, administers programs that facilitate home ownership and rental housing. The Denver Housing Initiatives system provides financing for acquisition and rehabilitation of housing and for adaptive reuse of non-residential structures. Projects are reviewed by several city and state housing agencies. Other housing programs Include the federal RRP, the CDBG program, and the Home Ownership Mortgage Interest Subsidy Program. Further, the city has worked closely with nonprofit housing advocacy groups to acquire and renovate old structures, including hotels for rehabilitation into housing for low- and moderate-Income households.

FIRE SAFETY

High-risk populations include the elderly, the very young, and people with limited ability to move without assistance. In Seattle, 15.4 percent of the population is 65 years old or older and 4.9 percent is five years old or younger. Physical handicaps limit the mobility of 1 percent of the population. To respond to the fire protection needs of the city, the Seattle Fire Department maintains the forces listed in Table 3-1.

TABLE 3-l
SEATTLE FIRE DEPARTMENT

Stations (engine and ladder) . . . . (average coverage of 2 square miles per station)	44
Engine Companies	33
Ladder Truck Companies	11
Firefighters . , ...	762
Firefighters on duty during each of 4 shifts	199
Fire Officers (Chiefs, Captains, Lieutenants] . .	227
Fire Suppression Battalions (average of 14.8 square miles per district]	6
Fire hydrants	17,000

Source: Seattle Fire Department.

It is likely that a city as large as Seattle will experience residential fire fatalities during a given year and that a disproportionate share of the victims will be either elderly or very young. Although the over-65 and under-five population combined represent only 20.3 percent of Seattle's population, Table 3-2 shows that these groups accounted for 65 percent of the fire fatalities during a recent two year period. Further, fire deaths are more likely to occur in low-income neighborhoods, defined as neighborhoods where the property values are lower than average and a higher than average proportion of people live in poverty. Capitol Hill in central Seattle is such a neighborhood, and as shown in Table 3-2. accounts for 18 percent of Seattle's fire fatalities even though only 5 percent of the city's population resides there.

TABLE 3-2
FIRE FATALITIES SEATTLE

YEAR	NUMBER OF CIVILIAN FIRE DEATHS (RESIDENTIAL)*	55 & OLDER / 5 & YOUNGER		IN CAPITOL HILL	
		#	%	#	%
1987	4	2	50	0	
1988	13	9	69	3	23
TOTAL	17	11	65	3	18

*Excludes suicides by fire.

Source: Seattle Fire Department

PROJECT INITIATION

The NAHB National Research Center's (Research Center) selection of Seattle, verified in a letter from Mayor Charles Royer. led to initiation of the Seattle Fire Department's (SFD) and the Seattle Department of Community Development's (DCD) participation in the technical assistance project. The Research Center notified SFD of the availability of federal money to increase fire safety among urban low-income populations, though the funding sources (U.S. Fire Administration [USFA] and the U.S. Department of Housing and Urban Development [HUD]) required the funds to be used in conjunction with other Community Development Block Grant (CDBG) and/or Rental Rehabilitation Program (RRP) funds allocated to the rehabilitation of low-income housing. Therefore, the Research Center informed SFD of the agency's responsibility to select two or more houses with a low-income population that were imminently scheduled to undergo rehabilitation using CDBG and/or RRP funds. In addition, SFD staff contacted the Seattle Water Department (SWD). They also identified a several buildings as potential sites for the program.

At an orientation meeting at the office of the Research Center in January 1988, Research Center staff met with Assistant Fire Marshal Gregory Dean of the SFD and Valerie-Heide Mudra of the Seattle DCD. Research Center staff outlined project goals and objectives, and ensuing discussion focused on ways to select a small set of single-family houses as well as on project reporting procedures. Most of Seattle's housing rehabilitation at that time was concentrated on multifamily dwellings. The discussion reiterated the research goals concerning single-family houses, and the Seattle representatives agreed to make selection of such dwellings their priority. Chief Dean, stating that the fire department was

in favor of the use of sprinkler systems in residential buildings, noted that the department would encourage their use in single-family as well as multifamily dwellings,

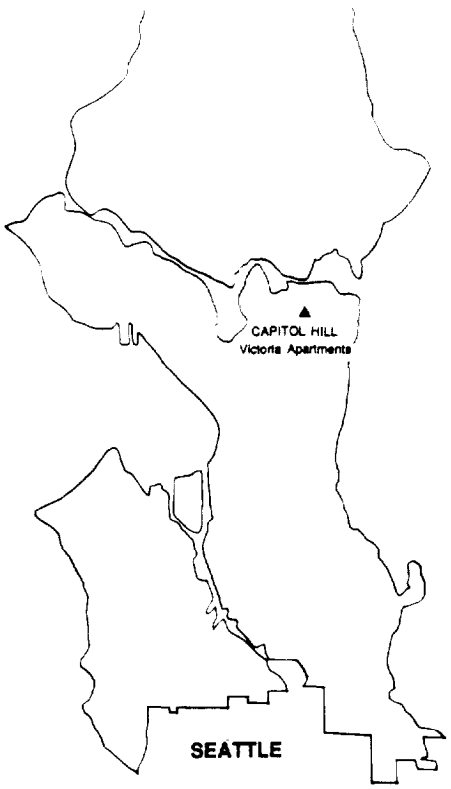
Soon after the initiation meeting, staff from the Research Center met in Seattle with staff from DCD and SFD. The meeting included review of rehabilitation plans for several types of residences. Later in the day, the project team visited the sites identified in the meeting as most likely for selection. The DCD arranged for owners to be present, and the project team reviewed briefly project goals and conducted short interviews regarding owners' interest in the project. After review of several potential sites, DCD contacted by letter the owners of the selected building, Mr. Randy Martens and Mr. William Chan, and informed them of the project goals. Soon after being invited to participate, Messrs. Martens and Chan agreed to join the project.

The letter from DCD stated the department's willingness to reimburse the owners for the costs of installing a fire sprinkler system, including design and site work. Funds for reimbursement would come from a grant to DCD from USFA, contingent on execution of a written agreement between DCD and the owners. The grant instrument from FEMA specified that costs were to be in accordance with the budget approved by USFA. with fire sprinkler installation (including design costing up to $12,000 and site work up to Site work included water main taps, water meter lines, and trenching. The budget also allocated $5.000 for a public outreach program. As was the case in other participating jurisdictions, the budget document stated the necessity of approval from the project assistance officer at FEMA for the transfer of funds in excess of 5 percent of the approved budget between budget categories. The owners agreed to pay any additional sprinkler installation costs above the budgeted amount.

All participants agreed to communicate regularly during the design phase, with meetings scheduled in Seattle as necessary and, if possible, in conjunction with site visits by Research Center personnel. The parties also agreed that telephone conversations and/or written communication would be necessary to secure input regarding system design. A photographic journal of the rehabilitation of the building was to be kept (by the Research Center), including the installation of the sprinkler system together with "before and after' views of construction.

After informing all participants of their roles and the overall goals of the program, the Research Center began the design phase of the sprinkler system.

FIGURE 3-l



BUILDING REHABILITATION

The building, located in the Capitol Hill section (see Figure 3-1), was originally a large single-family home built in 1902 that was converted to a nine-unit apartment house in 1947. Total square feet is 5,320. Total rehabilitation cost (excluding the sprinkler system) was $364,000.

The Research Center was asked to identify ways the building could be made more energy-efficient. The staff engineers' recommendations included in construction were:

- Replacement windows throughout the building. The windows bore a seal from the Washington State Energy Office. (Note: the first shipment of windows for the project was returned because they did not carry the official seal.)
- Space heating was reworked to provide individually metered electric resistance panel heaters.

The improved condition of the electrical heating systems also reduces the chance of a fire in the building. Some of the costs of the energy improvements were paid by the Seattle City Light Company as part of their grant-funded conservation program.

FIRE SPRINKLER SYSTEM DESIGN AND COST

The fire department decided on the use of NFPA standards as well as other technical requirements of the sprinkler system. Sprinkler system design was a coordinated effort between the Research Center, Mr. Mark Peterson (property manager), Mr. James C. Buchanan (fire protection consultant). Ms. Audrey Van Home (architect hired by the owners), Chief Dean, and Mr. Randy Martens, the owner. An overview of major issues in designing sprinkler systems is presented in the Introduction.

Water System

The hydraulic calculations and subsequent tests were based on two heads open simultaneously, a "two-head design." The SWD required the sprinkler systems to be tapped into the building's main water supply downstream of the meter, thus metering any water discharged from the sprinkler system. Friction loss within the meter is likely to cause a drop of five to ten pounds per square inch in the water pressure of the buildings. The SWD also required installation of a soft-seat check valve to prevent standing water in the sprinkler pipes from flowing back into the domestic water supply. Friction loss in the back-flow preventer is likely to cause a five to ten pound per square inch reduction in the water pressure of the sprinkler systems, the pressure losses in the meter and the check valve were factored Into the design delivery of the sprinkler heads. The system has a pressure gauge and a drain and test valve. The shutoff valve is located in an unlocked closet behind a washing machine. The sprinkler system can be shut off without special equipment, but the valve to do so will also close the domestic water supply. Closure of the domestic water system is predicted as likely to bring an immediate response from one or more of the building's residents. There is an external connection for water from a fire department pump or other emergency source.

The water pressure in the building was sufficient to allow use of pendent sidewall sprinkler heads in all rooms other than the laundry and storage areas. Ceiling pendent heads were used in the laundry and storage areas. The system design team also had to consider that the rehabilitation plan for the building did not include demolition of existing walls. Customarily, piping is concealed by walls and ceilings, but to do so in this project would have required work not planned and would, according to the project team, have significantly raised the cost of the system. Instead, the team

Victoria Apartments, Seattle, WA, Front View

Victoria Apartments, Seattle, WA, Rear View

decided to surface mount and hang the system piping exposed in living areas. Further, due to the complex configuration of the supply piping, the project decided against enclosing the piping

Coverage and Location

In the subject building in Seattle, there are 68 quick-response heads located a maximum of six feet from the walls, with 12 feet between pipes and sprinklers, and a minimum of eight feet between heads. As per specification of the SFD, sprinklers were installed in bathrooms and hallways but not in closets. The sprinkler heads were manufactured by Grinnell Fire Protection Systems Company and cost approximately $10 each.

Response Time/Activation of Sprinkler Heads

Sprinkler heads are generally set to discharge at no less than a maximum ambient temperature plus 35°F, generally between 135°F and 170°F in a residential environment. In the Seattle building, the heads are designed to discharge at 165°F. There is a flow-activated alarm switch connected to exterior alarm bells. There is no service to monitor and react to the alarm, though neighborhood residents will likely notify the SFD in the event of alarm activation.

Sprinkler System Plumbing

The pipes and risers in the subject building are made of copper rather than plastic. In exposed applications, copper is preferred over plastic by some sprinkler system design engineers and fire department officials because its superior strength makes it less susceptible to accidental damage or vandalism. In addition, copper sprinkler piping is usually more aesthetically pleasing than plastic. The SFD prefers metal rather than plastic in exposed fire sprinkler systems.

Table 3-3 shows the costs for design and installation of the fire sprinkler system, including contractor's mark-up and state sales tax. The high cost per square foot is consistent with the complicated nature of the sprinkler system.

TABLE 3-3
SPRINKLER SYSTEM COSTS

Work Category	Materials	Labor	Total
SYSTEM DESIGN	$ 0	b 500	$ 500
SYSTEM INSTALLATION:			
Mechanical (Includes (Includes pipe, fittings, valves, sprinkler heads, flow switch)	$7,239	$4,826	812,065
Architectural [Includes drywall, framing. carpentry)	$ 200	$ 800	$1.000
Electrical	$ 80	$ 200	$ 280
INDIRECT COSTS:			
Water Department/	$1,800	$ 0	$1,800
Permtts	$ 0	$ 200	$ 200
Plan Reviews/ Inspections	$ _0	$ 81	$ 81
NET COSTS OF SPRINKLER SYSTEM	$9,319	$ 6607	$15,926
Gen. Contractors Mark-Up @ 15%			$2,369
Wash. State Sales Tax @ 8.1%			$1483
TOTAL COST			**$19,798**
COST PER SQ. FT.	**$1.41**	**81.58**	**$3.72**
COST PER UNIT			**$1,980**

Source: Seattle Fire Department

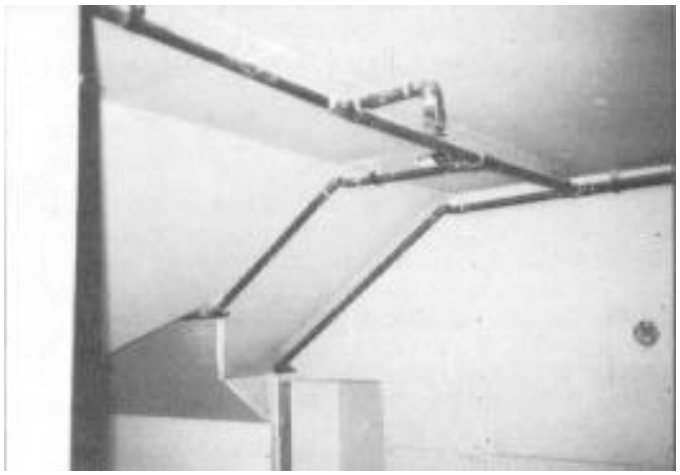
INSTALLATION AND TESTING

On September 9, 1988, the owners issued a notice to proceed to the sprinkler system design contractor. Design of the system was complete by September 19. Fire department officials approved the sprinkler system plans on September 23, 1988. Bids were received for the sprinkler system in the first week of October 1988. The contractor began installation of the system in late October 1988. Installation of the sprinkler system took three weeks and was completed by November 16, 1988. During January 1989, the SFD witnessed the code-required water pressure test. Overall rehabilitation of the building was finished in February 1989, and at that time a certificate of occupancy was issued by the city of Seattle.

Operation and Maintenance Costs

The owners of the Victoria Apartments estimate that costs for routine inspection and testing will be negligible, and the property taxes have not changed. It is too soon to assess costs from leakage and/or false activation. There is no external monitoring service. As mentioned above,

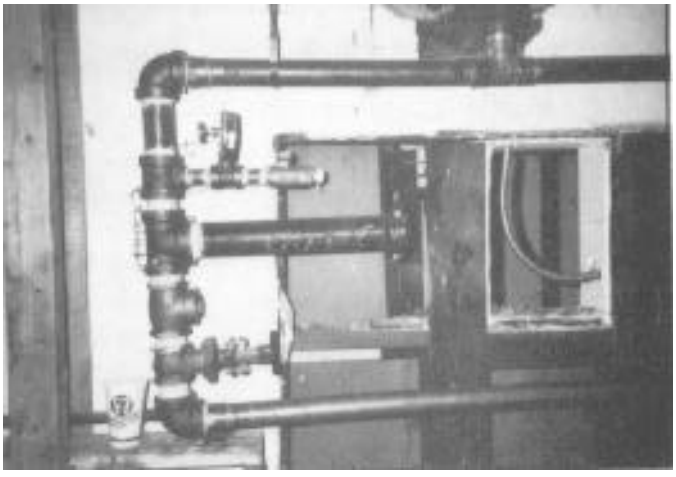
Pendent Sidewall Sprinkler Head Located in Staircase to Upper Apartments



Fire Sprinkler Branches in Top Floor Apartment. Copper Piping Was left exposed to the living spaces at the Victoria Apartments.

Sprinkler in Dormer in Top Floor Apartment. This unit was deemed a habitable space-by SFD because of the installation of fire sprinklers.

Pendent Sidewall Sprinkler Head in Furnace Area. Pendent sidewall heads were used throughout most of the Victoria Apartments.



Water Supply [not connected) and Control Valves. Note installer's sketch on background wall.

View of front door depicting branch to front porch where a freeze-proof dry pendent was employed.

there were no financing costs and no annual fee for water (water use, if any, will be metered).

One major goal of the sprinkler technical assistance project is to demonstrate sprinkler technology that may potentially decrease fire danger among "high-risk" urban populations. This goal, established by Congressional mandate, led the USFA, through HUD, to subsidize installation of sprinklers in buildings undergoing rehabilitation with money from other federal programs such as CDBG or RRP. This meant the owners of the particular buildings selected for participation (Messrs. Martens and Chan in Seattle) paid only a small portion of the design and installation costs. The grant amount designated for sprinkler design and installation in Seattle fell short of the actual cost by $2,798, and the owners paid the difference.

SPRINKLER SYSTEM BENEFITS

Insurance Policy Discount

The owners of the Victoria Apartments purchased a multiple-peril property insurance policy for $456 per year. They report that had there not been a fire sprinkler system present in the building, the policy would have cost $988. The $532 savings represents a 54 percent discount.

Improved Life Safety--Positive Effect on Rental Income

As a participant in the Seattle subsidized housing program, the owners must limit rents to "fair market" amounts as set by the Seattle DCD. Formulas similar to those used by HUD are used by DCD for establishing tenant payments and total rental revenue for building owners. Tenants must pay up to 30 percent of their gross income for rent, excluding utilities, or 35 percent including utilities. According to the owners and their contact at DCD, the presence of the fire sprinkler system was not included in the advertisement for the building, nor was it a factor in the official determination of rent levels for the single-family conversion.

Reduced Property Damage Costs and Property Insurance

The owners have a policy that covers full replacement value for property loss at the Victoria Apartments. The deductible is $250 per claim, and that sum should be the most the owners can lose in direct property damage per fire. It is also possible for them to incur property losses not directly related to a fire such as demolition and/or security of remaining property. Therefore, the reduced likelihood of a destructive fire in the Victoria Apartments reduces the chance of such

losses. Further, tenants may have insurance policies protecting against loss or damage to their personal property. Reduced probability of fire and potential discounts on tenants' contents insurance benefit tenants as well.

CONSTRUCTION ALTERNATIVES

Prior to rehabilitation, the attic and loft space at the top of the house were accessible by a single staircase only. Because of the single means of egress, the SFD planned to prohibit use of that area as a habitable dwelling. The owners did not add a second egress to the top floor and were planning to rehabilitate the nine existing residential units. With the addition of the fire sprinkler system, the SFD deemed the top floor habitable, thus increasing the rentable units from nine to ten. The rent for the top floor unit will be $400 per month, revenue due, in part, to the presence of the sprinkler system.

COMMUNITY OUTREACH

The SFD had constructed a two-story miniature house (24" x 36" base) displaying models of several fire safety systems. The model is constructed of plexiglass walls and a removable roof for ease of visibility of the interior fire systems. The SFD displays the house at a variety of public events, including special programs focusing on residential fire safety and events with more general themes. The house is also presented at shopping malls and other public places.

SEATTLE, WASHINGTON: THE CITY AND ITS HOUSING MARKET

A major focus of this project was to include sprinklers in housing rehabilitation. The houses included were undergoing rehabilitation funded by the CDBG program. As in most large cities, Denver administers a variety of housing improvement programs.

Table 3-4 provides a brief overview of the population and housing characteristics of Seattle, Washington.

Housing Services in Seattle

The city of Seattle administers both special programs and ongoing services for low- and moderate-income households.

Public Housing

Provides housing for low-income families, the elderly, and people with disabilities. Families qualify based on income guidelines established by the Seattle Housing Authority SHA).

TABLE 3-4
COMMUNITY PROFILE

Population (1980)	493,600
Population below 125% of poverty level	15.4%
Population 65 years old and older	15.4%
Population 5 years old and younger	4.9%
Population with limited mobility (U.S. Census deftned as persons with limited ability to use public transit)	
Total Housiq Units (1985)	229,927
Multifamily (five or more units)	47.7%
Single-Family	52.3%
Population density per square mile	5,548
Population density per housing unit	2.1
Housing units built before 1939	40.3%
Medtan Price (1985)	
Single-Family	
Combined types of rentals	$65,900
Vacancy Rate--Overall (1985)	4.5%

Source: Seattle Department of Community Development

Rental Subsidies

The SHA administers the HUD Section 8 rent subsidy program, including inspection of properties for minimally acceptable conditions.

Seattle Senior Housing Program

Provides affordable housing for income-eligible elderly aged 62 and up. Units are usually in low-rise woodframe apartment buildings. Applicants are required to verify that their income is not over $18,600 or $21,500 for one- and two-person families respectively.

Home Sharing for Seniors

Tenants of subsidized housing units are matched with elderly home owners for mutually beneficial reductions in costs of housing.

Home Sharing for Families

This is a program that counsels families wishing to share housing for reduction in costs of living.

Advisory Housing Code Inspections

Housing inspectors make advisory inspections upon request. Except for certain types of problems, the inspection is advisory rather than compulsory. The Seattle Department of

Construction and Land Use performs the inspections.

General Diagnostics Home Inspections

Three non-profit housing advocacy groups provide advisory diagnostic inspections of owner-occupied and tenant-occupied units.

Citywide Home Improvement Program

The SHA, the Central Area Public Development Authority, and the Ranier Home Loan Center provides home improvement loans at low interest to Seattle residents. Loan repayments are up to 15 years, with 4 percent interest to income-eligible households. An applicant must own and occupy the home and meet asset guidelines (excluding the home to be rehabilitated) and income guidelines.

Emergency and Housing Code repair

The Seattle DCD repairs high-hazard housing conditions, including emergencies, at low cost. Eligible households are those that meet income guidelines and are able to repay the total cost of repairs. This program targets households with incomes at or below HUD's CDBG program median-income levels. Repayment may be made over an extended period of time and carry either a 0 or 4 percent interest rate.

One of the research goals of the second phase of the sprinkler technical assistance project was to gain experience working with small cities or rural counties. Although similar in nature to the technical assistance provided to the large cities, the goal of the second phase was to expand the study of fire safety systems installed during federally funded housing rehabilitation.

PROJECT INITIATION

The NAHB National Research Center's (Research Center) selection of Ohio, verified in a letter from Governor Richard Celeste. led to initiation of the Ohio State Fire Marshal's (SFM) participation in the technical assistance project. The Research Center notified SFM of the availability of federal money to increase fire safety among low-income populations, though the funding sources (U.S. Fire Administration [USFA] and the U.S. Department of Housing and Urban Development [HUD]] required the funds to be used in conjunction with other Community Development Block Grant (CDBG) and/or Rental Rehabilitation Program (RRP] funds allocated to the rehabilitation of low-income housing. Therefore, the Research Center informed SFM of the agency's responsibility to work in conjunction with officials in selected small jurisdictions to identify houses with low-income residents that were imminently scheduled to undergo rehabilitation using CDBG and/or RRP funds. In addition, the Research Center requested SFM to evaluate potential sites for technical compatibility with fire sprinkler installation,

SFM staff contacted the fire department and the housing department or authority in several small cities or towns. They requested the respective officials to identify several buildings as potential sites for the program. The SFM goal in the project was to increase the effectiveness of local fire departments by offering research data on fire control technologies. In a recent four-year period, there was a relatively constant number of fire fatalities in Ohio as Table 4-l indicates.

TABLE 4-1

	1983	1984	1985	1986
Total Fires	66.79 1	61,791	63,446	64,990
Total Fire Losses*	$198	$223	$259	$210
Total Deaths	222	218	210	224
Deaths Pe.r 1,ooo Fires	3.3	3.5	3.3	3.4

* Dollars in millions

Sourer.: Ohio State Fire Marshal

At an orientation meeting at the office of the Research Center in January 1988. Research Center staff met with Chief Terry Weber of the Fire Prevention Bureau of the Ohio SFM. Research Center staff outlined project goals and objectives, including installation of fire sprinklers in a rural community or a city with a population less than 50,000 and therefore not a CDBG entitlement grantee. The Research Center staff emphasized that, like all nonentitlement grantees, the jurisdiction(s) selected would be dependent on state government distribution of development funding. In reiterating project goals, staff stressed the need to install sprinklers in houses whose rehabilitation was federally funded. It was also discussed that, unlike any sprinkler systems installed during the first phase of the project, consideration should be given to installation of fire sprinklers in a house not connected to a public water supply. The ensuing discussion focused on specifying the city, town, or rural county best suited to the goals of the project. All agreed that the SFM would need to explore the selection process further, with specific jurisdictions selected at a later date. Research Center staff noted several criteria for selection of houses for inclusion in the project, including timing of rehabilitation and financing. home owner attitudes toward sprinkler installation and follow-up publicity, water service, and household demographics.

The grant instrument from FEMA specified that costs were to be in accordance with the budget approved by USFA, with fire sprinkler installation (including design] costing up to $12,000 and site work up to $5,000. Site work included water main taps, water meter lines, and trenching. The budget also allocated $5,000 for a public outreach program. As was the case in other participating jurisdictions, the budget document stated the necessity of approval of FEMA's project assistance officer for the transfer of funds in excess of 5 percent of the approved budget between budget categories.

All participants agreed to communicate regularly during the design phase, with meetings scheduled in Ohio as necessary and, if possible, in conjunction with site visits by Research Center personnel. The parties also agreed that telephone conversations and/or written communication would be necessary to secure input regarding system design. A photographic journal of the project was to be kept by the Research Center, including the installation of the sprinkler system together with "before and after" views of construction.

Selection of Jurisdictions

Shortly after the initiation meeting, staff from the Research Center met in Columbus, Ohio, with staff from the Ohio SFM and the Ohio Department of Development. The meeting focused on selection of participating jurisdictions and sources of housing rehabilitation funding. State personnel identified several small cities and ensuing discussion highlighted information needed from each city regarding housing rehabilitation projects, fire safety programs, and past receipt of federal rehabilitation funding.

Personnel from the SFM office also expressed concern over the reporting requirements in the grant documents. In particular, they questioned the need for an arson reporting section, and the references to urban inner cities appeared relevant to multifamily and not single-family rehabilitation. Research Center staff agreed to work with FEMA to revise the language and the reporting requirements in the grant. In the next few months, an amended document was prepared by FEMA and sent to the SFM.

The Ohio officials considered it important to secure the requested changes in language and reporting requirements before proceeding with final selection of participants. They wanted to present to local officials actual grant documents with no pending changes. Unofficially, the SFM narrowed the list of potential jurisdictions to two sites, both in the general vicinity of Columbus. At the request of the Research Center, the SFM contacted high-ranking officials in the two cities identified as the most likely project sites, Marion and Galleon.

During the time FEMA was processing a new grant agreement for Ohio, issues developed with respect to both selected jurisdictions, Officials in Galleon expressed reservations over participation, and the SFM staff did not want to begin a project that appeared likely to encounter obstacles regarding project administration on the local level. In Marion, a problem arose with funding for single-family rehabilitation. Marion officials could not promise that funds would be available in time for the sprinkler project to proceed simultaneously with the project in the other sites. Without housing rehabilitation funds, the project could not move forward.

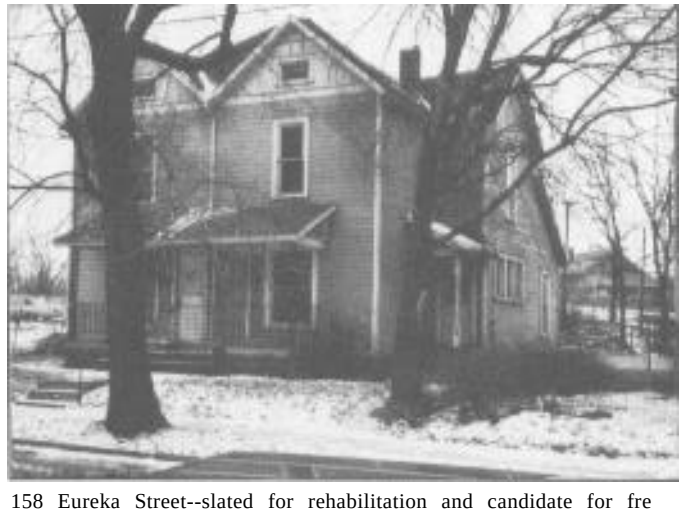
Due to state appropriation regulations, it was necessary to resolve the reporting and site selection issues before authority to spend the grant could be obtained. Officials from the SFM also considered it best to delay a request for expenditure authorization from the State Control Board until the problems were resolved. The entire project team established a tentative time frame for resolution of the problems and subsequent request for spending authority. As the agreed deadline approached and progress towards resolution remained elusive, the team decided to seek another jurisdiction for receipt of the sprinkler grant. After consulting with district divisions under the jurisdiction of his office, Chief Weber evaluated several suggested new sites. Based on the criteria of ease of administration, active rehabilitation projects, and familiarity between state and local fire officials, the city of Lima (near Indiana) was chosen. A key factor in the selection of Lima was the recommendation of Mr. Rollin Kerzee, fire prevention engineer for the SFM Western District. Mr. Kerzee, a former fire official in Lima, was able to secure an unofficial agreement from officials in Lima to participate and meet the stated project goals. Mr. Kerzee also informed the project team that most single-family houses in Lima have sufficient water pressure to supply a fire sprinkler system. While the water pressure was not a criterion for initial selection of a city or town, such advance information eased the selection of Lima.

The SFM began working with officials in Lima to identify specific sites for sprinkler installation. Early in the process, Lima officials contacted the REHAB PROJECT (RP), a nonprofit partnership of public and private sponsors that was actively rehabilitating homes throughout Lima.
in RP identified the Eureka Street rehabilitation project as the best location for the project and specified six potential single-family rehabilitation projects. Staff from the Research Center met with Chief Brookman of the Lima Fire Department, Mr. Kerzee. Chief Weber. and Mr. J. Howard Ellstro, the assistant director of RP. After the meeting, the project team visited several rehabilitation projects on Eureka Street. The team agreed on four houses that met the project criteria. The team also decided it would be best if the grant money was directly available to the team in Lima, thus easing contracting with sprinkler designers and installers. Chief Weber began the process to obtain authority to transfer control of the grant to the team in Lima. The transfer had to be approved by the State Control Board. In order for the board to consider such a matter, Chief Weber had to submit a request. From experience, the chief knew it would not be possible to receive the authority without written approval from FEMA stating that selection of Lima met the goals and requirements of the project. The Research Center requested and received such a notification from the FEMA contract officer for the project.

114 Eureka Street--slated for rehabilitation and city of Lima's parade of Homes." a public relations campaign focused on rehabilitated homes.

120 Eureka Street--slated for rehabilitation and candidate for fire sprinkler project.

119 Eureka Street--slated for rehabilitation and candidate for fire sprinkler project.



158 Eureka Street--slated for rehabilitation and candidate for fre sprinkler project.

After securing authority to transfer and spend the FEMA grant, it was necessary to seek a formal commitment to the project from the board of directors of REHAB PROJECT. Mr. Ellstro submitted a request to the board in December 1989. The board rejected participation because of three concerns:

- Potential water stand-by charges assessed to low-income home owners:
- The cost of the sprinkler system appeared inconsistent with their goals to rehabilitate and provide affordable housing: and
- Uncertainty over the reliability of fire sprinklers, liability for failure to operate when needed, and water damage from false activation.

Mr. Ellstro relayed these concerns to Chief Weber and to the Research Center. Each of the concerns has been expressed in a variety of formats and debates regarding residential fire sprinklers. One of the goals of this technical assistance project was to discover such constraints to sprinkler installations and ways to overcome them. Such constraints can often be solved with the cooperation of local officials using innovative financing and service charges, and through education. Unfortunately in the case of Ohio, the authority to pass control of the grant (State Control Board) expired on December 31, 1989, the same time the Research Center scheduled its conclusion of participation in the project. As of February 1990, the FEMA grant is still available to the State Fire Marshal, but the schedule and arrangements for sprinkler installations remain uncertain.

157 Eureka Street--After Rehabilitation.

PROJECT INITIATION

The NAHB National Research Center's (Research Center) selection of Florida, verified in a letter from Governor Robert Martinez, led to initiation of the state fire marshal's (SFM) participation in the technical assistance project. The Research Center notified the SFM of the availability of Federal grant money to increase fire safety among low-income populations, though the funding sources (U.S. Fire Administration [USFA] and the U.S. Department of Housing and Urban Development [HUD]) required the funds to be used in conjunction with other Community Development Block Grant (CDBG) and/or Rental Rehabilitation Program (RRP) funds allocated to the rehabilitation of low-income housing. Therefore, the Research Center informed the SFM of the agency's responsibility to work in conjunction with officials in selected small jurisdictions to identify houses with low-income residents and that were imminently scheduled to undergo rehabilitation using CDBG and/or RRP funds. In addition, Research Center staff requested the SFM to evaluate potential sites as to their technical compatibility with fire sprinkler installation. Per local regulations, the SFM sought and received approval to participate in the project from the intergovernmental coordinator for the Florida Division of Administration.

SFM staff contacted the fire department and the housing department or authority in several small cities or towns. They requested the respective officials identify several buildings as potential sites for the program. The SFM goal in the project was to increase the effectiveness of local fire departments by offering research data on fire control technologies. In a recent fiscal year there were 229 residential fire fatalities in Florida. Although not considered unreasonably high, the SFM is striving to reduce the annual number of fire fatalities.

At an orientation meeting at the office of Research Center in January 1988, Research Center staff met with Tony Barber, plans review engineer in the Bureau of Fire Prevention of the SFMs office. Research Center staff outlined project goals and objectives, including installation of fire sprinklers a rural community or a city with a population less than 50,000 and therefore not a CDBG entitlement grantee. Research Center staff emphasized that like all nonentitlement grantees, the jurisdiction(s) selected would be dependent on state government distribution of development funding. Further, Research Center staff reiterated that project goals call for the installation of sprinklers in houses whose rehabilitation was federally funded. Staff also discussed, that unlike any sprinkler systems installed during the first phase of the project, consideration should be given to installation of fire sprinklers in a house not connected to a public water supply. The ensuing discussion focused on specifying the city, town, or rural county best suited to the goals of the project. All agreed that the SFM would need to explore the selection process further and that specific jurisdictions would be selected at a later date.

Shortly after the initiation meeting, the SFM continued the selection process to identify the jurisdiction(s) meeting the stated criteria. Staffing requirements at the SFM led to assignment of Rick Ruh, also a plans review engineer in the Bureau of Fire Prevention of the SFM, as the project manager, with supervisory functions performed by Buddy Dewar and, later, by Mr. B.J. Peters.

The grant instrument from FEMA specified that costs were to be in accordance with the budget approved by USFA, with fire sprinkler installation (including design) costing up to $12,000 and site work up to $5,000. Site work included water main taps, water meter lines, and trenching. The budget also allocated $5,000 for a public outreach program. As was the case in other participating jurisdictions, the grant document stated the necessity of approval from the project assistance officer at FEMA for the transfer of funds in excess of 5 percent of the approved budget between budget categories.

All participants agreed to communicate regularly during the design phase, with meetings scheduled in Florida as necessary and, if possible, in conjunction with site visits by Research Center personnel. The parties also agreed that telephone conversations and/or written communication would be necessary to secure input regarding system design. A photographic journal of the project was to be kept by the Research Center including the installation of the sprinkler system together with 'before and after" views of construction.

SELECTION OF JURISDICTIONS

Shortly after the initiation meeting, staff from the Research Center met in Tallahassee, Florida, with staff from the SFM and from the Florida

Department of Community Assistance. The meeting focused on selection of participating jurisdictions and on sources of housing rehabilitation funding. State personnel identified several small cities, and ensuing discussion highlighted information needed from each city regarding housing rehabilitation projects, fire safety programs, and earlier receipt of federal rehabilitation funding. Staff from DCA noted the statewide competition among counties, towns, and small cities for CDBG funds, and offered to identify the housing rehabilitation cycle in each candidate jurisdiction. Also, there was discussion of the use of well-water systems in most small communities in Florida.

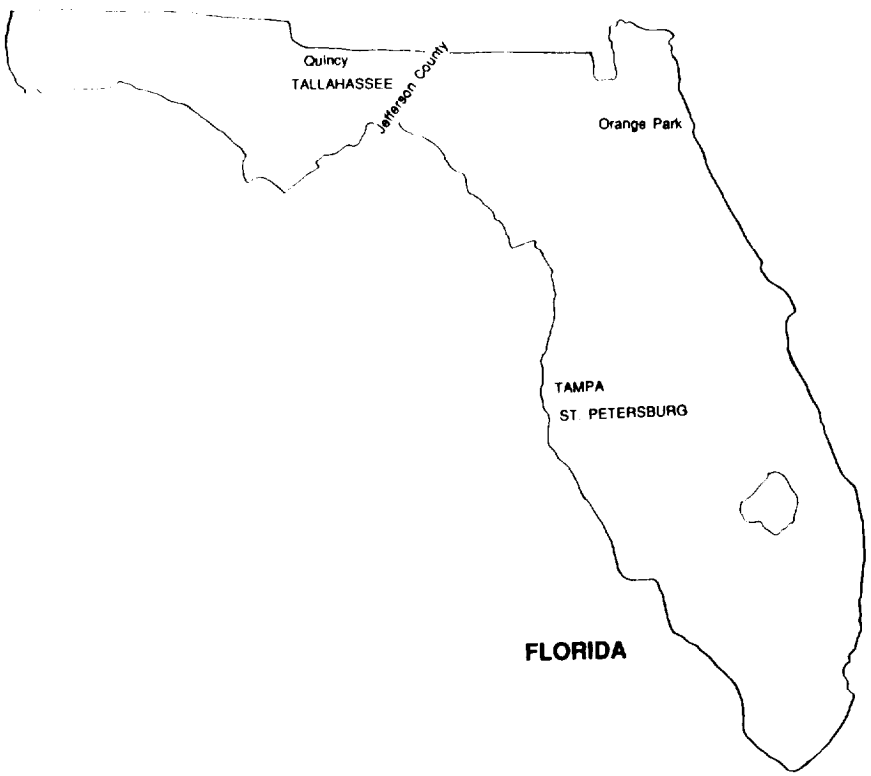
Research Center staff noted several criteria for selection of specific houses for inclusion in the project, including timing of rehabilitation and financing, home owner attitudes toward sprinkler installation and follow-up publicity, water service, and household demographics.

In the two months following the initial on-site meeting, Mr. Ruh met with officials In two small cities, Quincy and Orange Park (see Figure 5-1). Research Center staff subsequently visited city officials in Quincy and toured several small single-family houses targeted for participation in the project.

After the site visits, the project team met with Mr. Dewar who discussed a new fire sprinkler ordinance in Florida and expressed the SFM's support for the project. Mr. Dewar discussed Florida's two-tiered fire regulations, noting two levels of fire code--Uniform and Minimum, known as the SFM's Rules and Regulations. The minimum firecode is statewide and applies to all local jurisdictions, preempting any local code that is less stringent than the state code. The uniform codes is also statewide and applies to all special construction (e.g., hospitals, nursing‘- homes, service stations). Rick Ruh described the uniform laws as "no more and no less" type of regulations.

Mr. Dewar also discussed licensure requirements for sprinkler contractors noting that the state grants five levels of certification. Level- 1, for example, allows a contractor to sell and service portable fire extinguishers; Level-5 is highest and allows contractors to design, install, and service NFPA-13 systems. Usually a four-hour test is required for certification at Level-5 Level-4 applies to NFPA-13D contractors and was recently enacted to give certification to qualified plumbers. Plumbers qualify by evidencing the proper training in 13D design. Fire inspectors must be recertified every three years during which time they must participate in 40 hours of continuing education.

FIGURE 5-1



Mr. Dewar offered assistance from the Florida Fire Sprinkler Association (FFSA). headquartered in Tampa, in financing the project as well as in designing and installing the fire sprinkler systems. In July 1988, Mr. Dewar received approval from FEMA for placing a sole-source contract with FFSA. The approval from FEMA reiterated that direct responsibility for compliance with grant requirements would remain with the SFM. Further, FEMA stated that its approval of the sole-source contract did not constitute approval of costs charged by FFSA, nor did the approval constitute authority to incur costs in excess of the total estimated cost of the grant.

Shortly after receipt of the approval memo from FEMA. the SFM entered into a contract with the FFSA. The details of the contract include:

- The FFSA will not subcontract work to unlicensed contractors:
- The SFM's office will inspect and approve plans for sprinkler installation prior to commencement of work:
- The FFSA will notify nonmembers of the association of the project and allow them to participate:
- The SFM will pay $1.50 per square foot where existing water supplies are adequate and $1.91 per single-family where water supplies must be supplemented: as well as $1,000 for administrative costs;
- Funds for payment will come from the FEMA grant only, not from state money; and
- The SFM and FFSA agree that the Research Center will be provided data through periodic contact with the FFSA.

The contract was signed by Mr. Donald L. Stevenson, director, division of SFM; Mr. Mike Greshar. director of administration, state of Florida; and Mr. Charles (Chuck) DUnn director, FFSA.

SPRINKLER INSTALLATION

In keeping with the goal of including single-family houses, the Florida project team installed fire sprinkler systems in a total of seven houses. All seven houses are located in low-income neighborhoods with a predominance of minority households. Among the participating home owners are elderly. persons with physical disabilities, and single mother. The addresses of the participating homes follows (see Figure 5-l):

1448 Miller Street, Orange Park, FL
1402 Floyd Circle, Orange Park, FL
819 Seventh Avenue, Quincy, FL
4437 16th Avenue S., St. Petersburg, FL
8218 North Marks Street, Tampa, FL
1040 11th Street S., St. Petersburg, FL
Dill Community, Jefferson County, FL

In all of the houses NFPA 13D was followed, using a two-head design methodology. The following is a description of the fire sprinkler technical assistance project in each of the seven houses.

1448 MILLER STREET, ORANGE PARK

COST BREAKDOWN

	Materials	Labor	Total
System Design	$ 0	$ 275	$ 275
Mechanical (Includes Pipe, fittings, valves, sprinkler heads. flow switches)	$ 936	$ 546	$1,482
Permit.3	$ 50		$ 50
Plan Review and Inspection	$ 50		$ 50
Water Dept. Fees	$ 25		$ 25
TOTAL	**$1,061**	**$ 821**	**$1,882**
Donated Sprinkler Heads			$ 135
cost to Contractor			$1,747
cost per square foot (without donation]			$ 1.81
cost per square foot (with donation)			$ 1.40

Source: Florida Fire Sprinkler Association (FFSAJ

Comments

Captain Larry Dumas of the Orange Park Fire Department reports he is mostly satisfied with the sprinkler installation. His major concerns are the possibility of exposed water service [serves domestic and sprinkler systems) freezing during the two to three months when northern Florida experiences cold weather, as well as the possibility of low-income households not heating their homes sufficiently to warm the sprinkler pipes located between the ceiling and roof. He will monitor this situation and will seek to eliminate potential problems. Captain Dumas also discussed the need

1448 MILLER STREET, ORANGE PARK

House Size: 1,254 sq. ft. three bedroom: converted in 1989

Structural Data: Woodframe. stucco veneer, on block posts

Condition Prior to Rehabilitation: Formerly a barn. needs major repairs

Smoke Detectors: 1 batterv-powered

Energy Improvements: Double-pane windows and R-l 1 insulation

Total Rehabilitation Cost: $31.200, $24.88/sa. ft But rehabiliation

Total RFS Cost: $1,882 total cost, $135 of donated sprinkler heads - $1.50 sq. ft.

Sprinkler Contractor: Moore Pipe and Spinkler Co., Jacksonville, FL

Number of Heads, Pendent or Sidewall: 11 pendents Spare Heads None

Head Manufacturer: Central Sprinkler Corn--Omega brand

Placement in Non-required Areas (13D or other): None

Activation Temperature: 165°F Meter: 3/4 inch--outside

Water Service: New service adequate for fire sprinklers

Back-flow Prevention, Check Valves: Double check-valve one-inch

Flow Switch, Alarm Bell, Monitor: None

Shutoffs: Outside, unlocked, independent of domestic shutoff External Connections: None

Pressure Gauge, Test Valve: Gauge and valve on water supply. valves located behind refrigerator in kitchen

Pipe Material: CPVC

Exposed System, Drop Ceilings: None

System Tests: Static/flow tests approved by Orange Park Fire Dent: to be tested every 6 months

Installation Chronology: One week for design and one week for installation

Installation Problems: Sprinkler and electrical contractors both wanted to use center of ceiling for installation, would have meant disruption of sprinkler flow by light fixture, proper separation achieved

Operation Costs: Little to no expense anticipated

Benefits: Life safety and protection against uninsured losses

for better coordination between the sprinkler and the other contractors. Further, the Captain will conduct a brief training session for the household on the operation of residential fire sprinklers.

Sprinklered House at 1448 Miller St., Orange Park, FL.

Control Valves at Miller St. house were located behind the refrigerator to discourage tampering.

Exterior View of Sprinkler Water Connections at Miller St. Home.

1402 FLOYD CIRCLE, ORANGE PARK

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	6 0	8 122	$ 122
Mechanical (Includes pipe. Wings, valves, sprinkler heads, flow switches]	$566	$1,279	$1,845
Indtrect costs		$ 118	$ 118
Plans Rcvtew and Inspecttons	$ 92		$ 92
TOTAL	**$658**	**$1,510**	**$2,177**
Cost per Square Foot	$ .58	$1.33	$1.91

Source: FFSA

Comments

Captain Dumas was pleased with this installation and was less disappointed with the coordination between contractors on this site than the Miller Street site. He again expressed concern over potential freezing of the supply pipe and the ceiling lateral piping. He will monitor the situation and will address the potential problem. Further, he will conduct a brief training session for the household on the operation of residential fire sprinklers.

1402 FLOYD CIRCLE, ORANGE PARK

House Size: 1,140 sq. ft. three bedroom: 20 years

Structural Data: Woodframe on cinder-block posts

Condition Prior to Rehabilitation: Occupied, roof and ceilings dilapidated--moderate rehabilitation

Smoke Detectors: 1 battery-powered

Energy Improvements: Double-Pane windows and R-11 insulation

Total Rehabilitation Cost: $26,200, $22.98/sq. ft. moderate rehabilitation

Total RFS Cost: $2,177, $1.91 sq. ft.

Sprinkler Contractor: Moore Pine and Sprinkler Co., Jacksonville, FL

Number of Heads, Pendent or Sidewall: 5 pendents, 5 sidewall Spare Heads None

Head Manufacturer: Central Spinkler Corp. --Omega brand

Placement in Non-required Areas (13D or other): None

Activation Temperature: 165°F Meter: 3/4 inch--outside

Water Service: New service adequate for fire sprinklers

Back-flow Prevention, Check Valves: Double check-valve one-inch in utility room

Flow Switch, Alann Bell, Monitor: None

Shutoffs: Outside, unlocked, independent of domestic shutoff External Connections: None

Pressure Gauge, Test Valve: Gauge on water supply, test valve outside

Pipe Material: CPVC

Exposed System, Drop Ceilings: None

System Insulation: Pine in ceiling covered, outdoor water service exposed

System Tests: Static/flow tests approved by Orange Park Fire Dept; to be tested every 6 months

Installation Chronology: One week for design and one week for installation
Installation Problems: None
Operation Costs: Little to no expense anticipated

Benefits: Improved life safety; protection against uninsured losses

Sprinklered House at 1402 Floyd Circle, Orange Park, FL.

819 SEVENTH AVENUE, QUINCY

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	$ 0	$ 275	$ 275
Me-chanical (Includes pipe. l3tungs. VaIves, sprinkler heads, flow switches)	$495	$ 960	$1,455
TQTAL	**$495**	**$1,236**	**$1,780**
Cost per Square Foot	$.41	$ 1.01	$ 1.42

819 Seventh Avenue, Quincy

Comments

Officials from the city of Quincy Bureau of Public Safety, Division of Fire are pleased with the installation. They expressed concern that the presence of the smoke detector in the dwelling may have made the flow switch an unnecessary expense.

819 Seventh Avenue, Qunicy, Interior View

819 Seventh Avenue, Quincy, Exterior View

819 SEVENTH AVENUE, QUINCY

House Size: 1,218 sq. ft. one-story; three-bedroom: 50 to 60 years old

Structural Data: Woodframe on cinder-block posts

Condition Prior to Rehabilitation: Moderate repair needs

Smoke Detectors: 1 battery-powered

Energy Improvements: R-19 insulation in ceiling and R-11 in walls; solid core exterior doors; weatherized window openings; new energy efficient hot water heater; underpinned and enclosed area under house

Total Rehabilitation Cost: $22,930, $18.82/sq ft. major, not gut, rehabilitation

Total RFS Cost: $1,730, $1.42 Sq. ft.

Sprinkler Contractor: West Florida Pipe Company, Inc., Marianna, FL

Number of Heads, Pendent or Sidewall: 10 pendents

Head Manufacturer: Central Sprinkler Corp.--Omega brand

Placement in Non-required Areas (13D or other): None

Activation Temperature: 165°F Meter: In front yard

Water Service: Existing water service adequate

Back-flow Prevention, Check Valves: Double check-valve, underground

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoffs: Access to shutoff and the valve are unlocked External Connections: None

Pressure Gauge, Test Valve: Both located outside

Pipe Material: CPVC

Exposed System, Drop Ceilings: None

System Tests: Static test performed by (Quincy) Fire Department

Installation Chronology: One week for design and two days for installation

Installation Problems: Confusion between installer and city over responsibility for water tap, city provided after three-week delay; confusion between electrical and sprinkler contractors, locating ceiling fixtures and sprinkler heads--resolved during system design

Operation Costs: Little to no expense anticipated

Benefits: Improved life safety; protection against uninsured losses

JEFFERSON COUNTY

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	$ 0	$ 200	$ 200
Mechanical (Includes pipe, fittings. valves, sprinkler heads, flow switches)	$919	$1,114	$2,033
Indirect costs	$ 25	$ 34	$ 59
TOTAL	**$944**	**$1,348**	**$2,292**
Cost per square foot	$.81	$ 1,15	$ 1,96
Total w/out donation		$4,542	
Cost per square foot		$3.08	

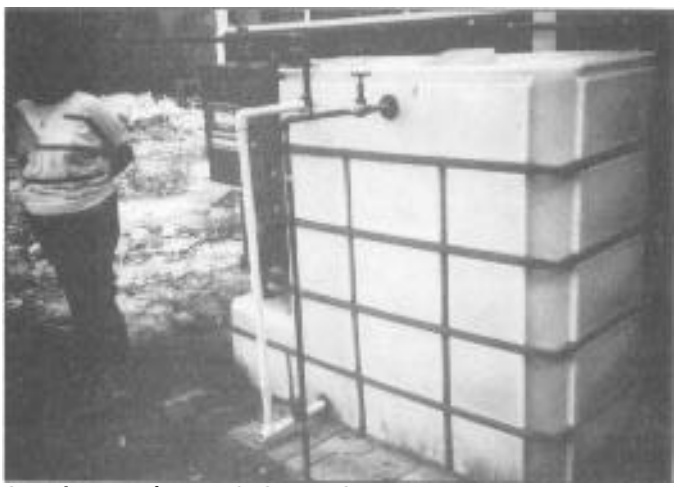
Pump and reservoir system, located behind house.

Comments

Components of the pump and storage system include a pressure sensor that activates the pump when water flows through the sprinkler system, a test valve, a drain valve, a swing check valve for back-flow prevention, and a flow switch connected to an alarm bell.

The pump and reservoir system was donated to the project by Home Fire Sales Inc., (HFS) of Annapolis Junction, MD. The system is named 'The D System." According to a price list distributed by HFS the components used in this installation, a "D" system with 1.5 horsepower pump and 440-gallon storage tank costs $2,250.

It is important to note that had the costs listed above been included in the cost of the fire sprinkler system, the system would have cost $4,542, or $3.88 per square foot.



Second View of Pump & Storage System

Control panel for pump & storage system.

JEFFERSON COUNTY

House Size: 1,170 sq. ft. one-story; two-bedroom

Structural Data: Woodframe on brick posts

Condition Prior to Rehabilitation: Major repair needs

Smoke Detectors: 1 battery-powered

Energy Improvements: New windows, solid core doors, new insulation

Total Rehabilitation Cost: $21,500 ($18.38/sq. ft.)

Total RFS Cost: $2,292 ($1.96 sq. ft.)

Sprinkler Contractor: Selasco Sprinkler Company, Jacksonville, FL

Number of Heads, Pendent or Sidewall: 11 pendents Spare Heads: none

Head Manufacturer: Central Sprinkler Corp.--Omega brand

Placement in Non-required Areas (13D or other): None

Activation Temperature: 165°F Meter: No meter on well system

Water Service: Existing well water service supplemented by a stored water system

Back-flow Prevention, Check Valves: Single check-valve, no pump

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoffs: Access to shutoff and the valve are unlocked External Connections: None

Pressure Gauge, Test Valve: Both located on pump, as is a pressure sensor

Pipe Material: CPVC

Exposed System, Drop Ceilings: None

System Tests: System not tested

Installation Chronology: One week for design and two days for installation

Installation Problems: None with sprinkler system, some responsibility coordination problems for support components for the pump and storage system

Operation Costs: Little to no expense anticipated unless pump system malfunctions

Benefits: Improved life safety: protection against uninsured losses

4437 16TH AVENUE SOUTH, ST. PETERSBURG

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	$ 0	$ 168	$ 168
Mechanical (Includes Pipe, fittings, valves, sprinkler heads, flow switches	$1,053	$ 496	$1,549
Electrtcal		$ 210	$ 210
Permtts	8 39		$ 39
Plans Review/Inspection	$	$ -	$ 35
TOTAL	**$1,092**	$ **874**	**$2,001**
cost per square foot	$ 1.04	$ .83	$ 1.90

8ource: FFSA

upsizing of the water service would have led to an increase from $9.61 to $24.60 in the monthly fee for water service. Fire Marshal Hawkins opposed an increase of $15 per month in water fees for the fire sprinkler system, especially in light of the fact that any water used by the sprinkler system will be metered at the same rate as the domestic water used in the home. Further, the nature of the project, to enhance the fire safety of low- income residents, would not be consistent with a 166 percent increase in monthly water bills. The solution to this problem was to install a separate water supply for the fire sprinkler system that was tied directly to the city water supply and would be exempt from the monthly charge. Water use, if any, in the fire sprinkler system will be metered. The one-time tap-fee for the new line was $270; however, the grant to the city covered the tap-fee as part of the rehabilitation of the house.

Exterior view of Sprinklered House at 16th Avenue South

Comments

Fire Marshal Hawkins of the St. Petersburg Fire Department is pleased with the installation. He commented on the initial difficulty he had in obtaining agreement from the home owner to participate in the project. The reluctance seemed to stem from lack of knowledge among the general public about residential fire sprinkler systems.

The St. Petersburg Water Department charges a monthly base rate in addition to metering water consumption in residential dwellings. The existing water service to this dwelling was not adequate to operate a fire sprinkler system. The size was 5/8-inch by 3/4-inch, and the St. Petersburg Fire Department determined that a l-inch line would be needed. According to the director of St. Petersburg's Department of Public Utilities, the

Water service to Sprinkler System, with valve tags and user's guide

4437 16TH AVENUE SOUTH, ST. PETERSBURG

House Size: 1,050 sq. ft. one-story; three-bedroom; 30-35 years old

Structural Data: Woodframe

Condition Prior to Rehabilitation: Roof, kitchen, and porch badly deteriorated

Smoke Detectors: 1 battery-powered

Energy Improvements: New insulation in attic, high-efficiency hot water heater

Total Rehabilitation Cost: $18,952 ($18.04/sq. ft.)

Total RFS Cost: $2,001 ($1.90 sq. ft.)

Sprinkler Contractor: Gulf Fire Sprinkler, Inc.

Number of Heads, Pendent or Sidewall: 11 pendents Spare Heads: none

Head Manufacturer: Reliable Sprinklers Co., Mt. Vernon, NY

Placement in Non-required Areas (13D or other): None

Activation Temperature: 160°F Meter: Separate meter for both water systems

Water Service: New water service for sprinklers

Back-flow Prevention, Check Valves: Swing check-valve for backflow

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoffs: Shutoff valve not locked but is in a located shed (a sprinkler head is in shed)

External Connections: None Pressure Gauge, Test Valve: both located in shed

Pipe Material: CPVC, galvanized steel water service

Exposed System, Drop Ceilings: None

System Tests: System not tested

Installation Chronology: Two days for design and five days for installation

Installation Problems: 105 ft. underground water service connection required to provide separate service for sprinklers

Operation Costs: Little to no expense anticipated

Benefits: Insurance discount pending; improved life safety; protection against uninsured losses

Some Water Departments Require New Metered Water Supplies to Sprinkler Systems. New Meter Box is Shown Here Adjacent to Existing Meter.

Sprinklered House at 1040 11th Street South

1040 1lTH STREET SOUTH, ST. PETERSBURG

COST BREAKDOWN

Category	Materials	Labor	Total
System Deslgn	$ 0	$ 496	$ 496
Mechanical (Includes pipe fittings, valves, sprinkler heads, flow switches)	732	$ 890	$l,622
Electrical	$ 78	$ 84	$ 162
Permits	$ 44	$ 37	$ 81
Plans Review/Inspection	$ 358	19	$ 54
Water Dept.	$ 500	$ 19	$ 519
TQTAL	**$1,389**	**$1,545**	**$2,934**
Cost per square foot	$ .91	$ l	1.91

Source: FFSA

New Water Service for Sprinkler System at 11th Street Home. Supply valve was locked with lock and chain to prevent valve closure.

1040 1lTH STREET SOUTH, ST. PETERSBURG

House Size: 1,536 sq. ft., two-story; two-bedroom: circa, 1952

Structural Data: Cinder-block frame first floor, woodframe second floor

Condition Prior to Rehabilitation: Dilapidated roof, other moderate repair needs

Smoke Detectors: 2 battery-powered

Energy Improvements: New metal doors, insulation, and high-efficiency hot water heater

Total Rehabilitation Cost: $18.945 ($12.33/sq. ft.)

Total RFS Cost: $2,934 ($1.91 sq. ft.)

Sprinkler Contractor: Suncoast Fire Sprinkler Company

Number of Heads, Pendent or Sidewall: 14 pendents Spare Heads: none

Head Manufacturer: Reliable Sprinklers Co., Mt. Vernon, NY

Placement in Non-required Areas (13D or other): None

Activation Temperature: 135°F Meter: Separate meter for both

Water Service: New water service for sprinklers

Back-flow Prevention, Check Valves: Swing check-valve for backflow

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoffs: Locked shutoff valve outside External Connections: None

Pressure Gauge, Test Valve: 2 pressure gauges, one on either side of check valve; 1 test valve, all in basement garage

Pipe Material: CPVC

Exposed System. Drop Ceilings: None

System Tests: System not tested

Installation Chronology: Two days for design and five days for installation

Installation Problems: Dimculty coordinating with home owner

Operation Costs: Little to no expense anticipated

Benefits: Insurance discount pending; improved life safety; protection against uninsured losses

Typical Finished Ceiling with Conventional Pendant-Type Sprinkler Head

Sprinklered House at 8218 North Marks Street

218 NORTH MARKS STREET, TAMPA

COST BREAKDOWN

Category	Materials	Labor	Total
System Design	$ 0	$ 430	$ 430
Mechanical (Includes pipe. fittings. valves, sprlnkler heads, flow switches)	$ 909	$ 596	$1,505
Electrical	$ 215		$ 215
Permits	$ 50		$ 50
Water Dept.	$ 100	$ 250	$ 350
TOTAL	**$1,274**	**$1,276**	**$2,550**
Cost per square Foot	$ .75	$ .75	$ 1.50

Source: FFSA

Sprinklered homes were selected from a pool of houses rehabililtated with HUD funding.

218 NORTH MARKS STREET, TAMPA

House Size: 1,700 sq. ft., one-stow; four-bedroom: four years old

Structural Data: Block frame, metal studs

Condition Prior to Rehabilitation: Moderate repair needs

Smoke Detectors: 2 battery-powered

Energy Improvements: New solid core doors, replace window unit air conditioners with central air conditioning

Total Rehabilitation Cost: $22,500 ($13.23/sq. ft.)

Total RFS Cost: $2,550 ($1.50 sq. ft.1

Sprinkler Contractor: AA4 Fire Protection, Inc.

Number of Heads, Pendent or Sidewall: 14 pendents Spare Heads: none

Placement in Non-required Areas (13D or other): None

Activation Temperature: 160°F Meter: Will be metered

Water Service: Existing one-inch supply adequate

Back-flow Prevention, Check Valves: Swing gate check valve

Flow Switch, Alarm Bell, Monitor: Flow switch and alarm bell, no monitor

Shutoffs: Shutoff not complete External Connections: None

Pressure Gauge, Test Valve: Both located in utility shed

Pipe Material: CPVC

Exposed System, Drop Ceilings: None

System Tests: Static test witnessed by Tampa Fire Department

Installation Chronology: Three days for design and three days for installation

Installation Problems: Some problems coordinating government and contractor officials

Operation Costs: Little to no expense anticipated

Benefits: Improved life safety: protection against uninsured losses

Rehabilitation of North Marks Street House included measures taken to enhance accessibility to wheelchair occupant. Shown here is a wall switch lowered to 42 inches.

OUTREACH

The SFM has produced a public service announcement (PSA) stating that sprinklers can "save your family's life" and asking viewers to call a toll-free number for more information about residential fire sprinklers. The PSA will be distributed throughout the state of Florida. In addition, the SFM conducted a series of public information events for housing-related organizations throughout the state. The events emphasized the sfm goal to have builders include sprinklers as an option for buyers. Further, the SFM regularly distributes literature on fire safety and has recently produced a brochure on residential fire safety systems intended to increase public awareness of the systems and to dispel what the SFM calls myths and misconceptions about fire sprinklers.

* U.S. G.P.0.:1992-625-441:60534