CITY AND COUNTY OF SAN FRANCISCO
BOARD OF SUPERVISORS
BUDGET AND LEGISLATIVE ANALYST
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POLICY ANALYSIS REPORT

To: Supervisor David Campos
From: Budget and Legislative Analyst's Office
Date: November 21, 2016
Re: Policies and Impact of Installing Sprinklers in Residential Buildings

SUMMARY OF REQUESTED ACTION

Pursuant to your request, this report: (1) presents key facts on the status of residential buildings with sprinklers, the breakdown of types of buildings, and the causes of residential fires; (2) estimates the cost of retrofitting existing buildings with new sprinkler systems; and (3) discusses best practices for incentivizing landlords to install sprinkler systems and ensure tenants are not displaced permanently due to sprinkler installation.

For further information about this report, contact Severin Campbell at the Budget and Legislative Analyst's Office.

Executive Summary

- Recent fires in large apartment buildings in San Francisco have resulted in property damage, loss of housing, and in some instances, loss of life. These fires have highlighted the need to re-examine the City's fire safety policies in residential buildings. There were 252 two-alarm or greater residential fires from 2004 to 2016. Most of these fires (63 percent) were accidental while 8 percent were intentionally or deliberately set. The cause of more than one-third of these fires was not determined; electrical, open flame, and smoking materials caused most of the fires for which a cause was determined. Wood-framed buildings, the most common building type in San Francisco, made up 87 percent of the fires.
- The San Francisco municipal code requires the installation of sprinkler systems in new and renovated apartment buildings and specific locations in existing apartment buildings. Sprinkler systems are intended to aid in the control of fires and protect against injury and loss of life in the event of a fire. San Francisco requires installation of sprinklers in new construction and in existing commercial buildings, tourist hotels, and single room occupancy (SRO) hotels with more than 20 rooms. San Francisco only requires installation of sprinklers in garbage chutes and in renovated areas in existing apartment buildings. Sprinklers must be installed in the entire apartment building only when a floor is added or a basement is made habitable.

- We did not identify other cities that required comprehensive fire sprinkler retrofit of existing apartment buildings. Requirements to install sprinklers in existing apartment buildings are uncommon, unless the building is undergoing renovation, and generally opposed by building owners. The deterrent to requiring installation of sprinklers in existing buildings is cost and impact to the residents.
- The National Fire Protection Association (NFPA) sets the standards for sprinkler installation in commercial and residential buildings. Based on these standards, we estimate that the base costs to install fire sprinklers in existing apartment buildings would range from $46,000 in a three-unit building and $113,000 to $300,000 in a 16-unit building, depending on the size of the building. The actual costs to install sprinklers could be significantly higher for any building that requires new pipes to be run in the walls or ceiling. Under San Francisco's Residential Rent Stabilization and Arbitration Ordinance, property owners can pass through the costs of sprinkler installation to tenants.
- As a first step to increase fire safety, the Board of Supervisors could expand requirements to install hard-wired smoke detectors in existing apartment buildings. Currently, property owners are only required to install hard-wired smoke detectors in apartment buildings that are newer construction.
- Consideration to require installation of sprinklers in existing apartment buildings should target high-risk buildings, including buildings that have repeated failure to abate fire safety violations. Avoiding tenant displacement may not be easy if the work to install sprinklers in existing apartment buildings is extensive. The risk to tenants could be reduced by (1) implementing a program similar to the City of Los Angeles' "Dorothy Mae Ordinance" in which automatic sprinklers are installed in all existing apartment buildings of three stories or more in common areas and inside entry doors in each residential unit; and/or (2) phasing in sprinkler installation in residential units between tenants.
- If the City were to adopt policies to require installation of sprinklers in occupied residential units of existing apartment buildings, any proposed policy should (1) establish mechanisms to relocate tenants and responsibility to pay relocation costs, and (2) provide for the return of tenants to their units once installation is completed. If the Board of Supervisors were to require installation of sprinklers in existing apartment buildings, the Board should also consider implementing a loan program, similar to the seismic safety loan program.

Project Staff: *Jennifer Millman, Hampton Smith and Severin Campbell*

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The Problem of Large Residential Fires

Recent fires in large apartment buildings in San Francisco have resulted in significant property damage, loss of housing, and in some instances, loss of life. These fires have highlighted the need to re-examine the City's fire safety policies in apartment buildings. Two fire protection systems – hard-wired smoke detectors and sprinklers – are required for new construction but are only required in existing apartment buildings under specific circumstances.

Currently, property owners are only required to install battery-operated, and not hard-wired, smoke detectors in existing buildings if the buildings were not previously wired for smoke detectors.

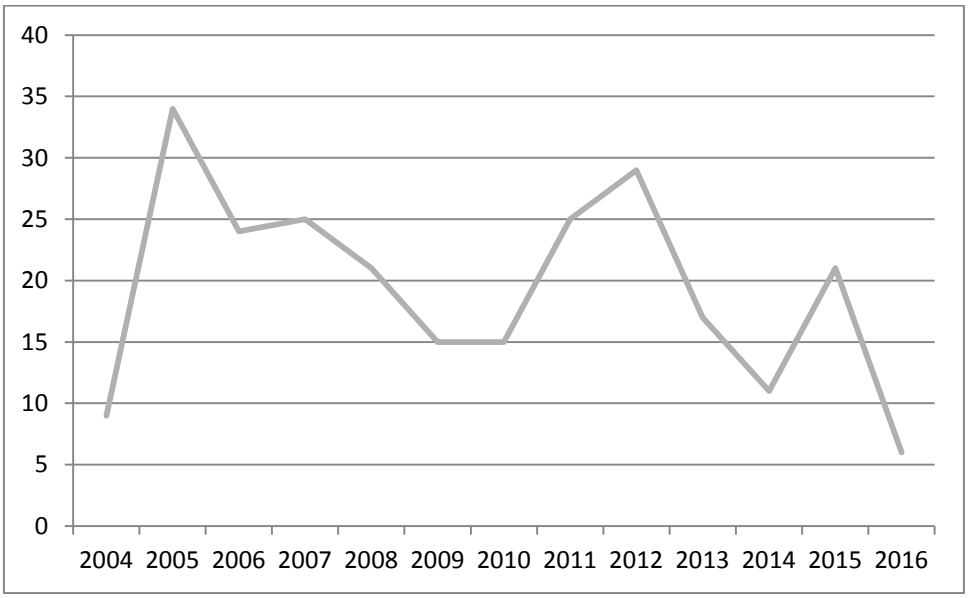
The requirements for installing sprinkler systems vary, depending on the type of building and when the building was constructed, as discussed in detail below. Existing tourist and residential hotels have more stringent requirements to install sprinkler systems than existing apartment buildings. Single room occupancy (SRO) hotels of 20 or more guest rooms must install sprinkler systems. Tourist hotels must install sprinklers in all common areas of the hotel. Older apartment buildings, depending on the size of the building, are only required to install sprinklers in garbage, laundry, and storage areas, and in dead-end corridors.

Historic Trends in Large Residential Fires

There have been 252 two-alarm[1] or greater residential[2] fires since July 2004, the earliest date for which information is available, with a high of 34 fires in 2005 and a low of seven fires in 2016, through August 2016. In the last five years, the greatest number of two-alarm or higher fires occurred in 2012 (29 fires).

[1] A two-alarm fire response involves 22 apparatus and 66 personnel in San Francisco. The highest response level (fifth alarm) involves 46 apparatus and 146 personnel. SFFD has 312 suppression personnel staffed daily and approximately 70 apparatus in service daily, not including ambulances.
[2] Hotels/motels are included in residential category of San Francisco Fire Department's (SFFD's) data management system.

Exhibit 1: Two-Alarm or Greater Residential Fires per Year



Source: SFFD

Cause

Of the 252 fires, 159 (63 percent) were accidental, 19 (8 percent) were incendiary (intentionally or deliberately set), 71 (28 percent) had an undetermined cause, and three (1 percent) are still under investigation, as shown in Table 1 below.

Table 1: Number of Fires by Cause

Cause	Number	Percent
Accidental	159	63%
Undetermined	71	28
Incendiary	19	8
Under Investigation	3	1
TOTAL	252	100%

Source: SFFD

Method of Ignition

The San Francisco Fire Department (SFFD) was able to identify the method of ignition in nearly two-thirds of the fires, but 93 (or 37 percent) had an undetermined method of ignition. The main identifiable ignition sources were electrical (16 percent), open flame (16 percent), smoking (12 percent), combustibles close to heat (9 percent), and ignition of vapors (3 percent), as shown in Table 2 below.

Table 2: Number of Fires by Method of Ignition

Ignition	Number	Percent
Undetermined	93	36.9%
Electrical	41	16.3
Open Flame	41	16.3
Smoking Materials	29	11.5
Combustibles Close to Heat	22	8.7
Ignition of Vapors	7	2.8
Spontaneous Heating	4	1.5
Fireplace	3	1.2
Mechanical	3	1.2
Roofing Activities	2	0.8
Other	7	2.8
TOTAL	252	100%

Source: SFFD

Construction Type

Most of the fires (87 percent) occurred in wood-framed buildings, with approximately 5 percent in masonry buildings, 4 percent in concrete buildings, 2 percent in metal buildings, and 2 percent unspecified, as shown in Table 3 below.

Table 3: Number of Fires by Cause

Construction Type	Number	Percent
Wood	218	86.5%
Masonry	13	5.1
Concrete	11	4.4
Metal	4	1.6
Unspecified	6	2.4
TOTAL	252	100%

Source: SFFD

Origin Location

The most common origin locations were a bedroom (24 percent), the exterior (14 percent), living room (13 percent), kitchen (10 percent), and garage (8 percent). The location could not be determined in 23 of the 252 fires (9 percent), as shown in Table 4 below.

Table 4: Number of Fires by Origin Location

Location	Number	Percent
Bedroom	60	23.8%
Exterior	36	14.3
Living Room	33	13.1
Kitchen	24	9.5
Undetermined	23	9.1
Garage	21	8.3
Stairs	8	3.2
Bathroom	7	2.8
Attic	5	2.0
Hallway	5	2.0
Storage	5	2.0
Roof	4	1.6
Other	21	8.3
TOTAL	252	100%

Source: SFFD

Installation of Fire Sprinklers in Apartment Buildings

Automatic sprinkler systems are intended to aid in the control of fires and protect against injury and loss of life in the event of a fire. Sprinkler systems are only activated in the direct area where a fire is located, as opposed to where smoke is detected. A report by the National Fire Protection Association (NFPA), which publishes standards governing sprinkler system requirements, found that the death rate per 1,000 reported residential fires was 82 percent lower in dwellings with sprinkler systems as compared to dwellings with no sprinkler system.[3]

The San Francisco Fire Safety Task Force (Task Force)[4] submitted a report to the Board of Supervisors in January 2016 with findings and recommendations to improve fire safety in multi-unit residential and multi-use buildings. The report listed several concerns about requiring installation of fire sprinkler systems in existing apartment buildings, including the complexity of the project, cost to the property owners, and impact to the tenants through the pass-through of costs or relocation during construction. According to the Task Force:

> "The advisability of requiring the installation of a retroactive sprinkler system to existing multi-unit buildings should be predicated upon the

[3] Hall, John. "U.S. Experience with Sprinklers." National Fire Protection Association. June, 2013.
[4] The Task Force was created by the Board of Supervisors in July 2015 to make recommendations for legislation and other solutions to improve fire safety in multi-unit and multi-use buildings.

factors delineated above. Upgrading fire alarm systems should be considered a consensus approach while post fire investigative reporting is reformatted to provide more specific information regarding the causes of fires and how fire safety systems and construction types perform when such evidence is available."

National Sprinkler Standards

Sections of the San Francisco Building, Fire, and Housing Codes require the installation of sprinkler systems in specific buildings and types of rooms (see Appendix I to this report for the relevant code). The relevant municipal code sections indicate which NFPA standard the sprinkler systems must meet. Residential buildings are required to meet NFPA standards 13, 13D, or 13R, which govern the design, installation, and testing requirements for sprinkler systems.

The NFPA 13 standards are more stringent than the NFPA 13R and 13D standards. NFPA 13R standards are for low-rise residential buildings up to four stories in height. NFPA 13D standards are for one- to two-unit residences.

Table 5: Primary Differences between NFPA 13 and 13R Standards

Category	NFPA 13	NFPA13R
Sprinkler Purpose	Life safety and property protection	Life safety
Permitted applications	Any application	Limited to apartment houses, hotels and related buildings up to four stories
Water source	Separate "fire line" required	Combination domestic and fire sprinkler is acceptable if less than 160 gallons per minute is needed
Water flow requirements	Generally 400 to 800 gallons per minute	Between 75 and 100 gallons per minute
Fire Department Connection	Required	Required

Source: SFFD

The 13R and 13D standards are *life safety* standards developed to encourage the use of fire sprinklers in residences including homes and multiunit buildings by reducing the requirements and cost of the higher NFPA 13 standard, which was intended for commercial property protection. Although NFPA 13D and 13R provide some measure of property protection, the primary purpose of life safety standard sprinkler systems is to allow adequate time for escape.[5]

[5] California Coalition White Paper Limit Local Amendments to Sprinkler Requirements

NFPA Standards for Types of Buildings

Commercial and residential high-rise buildings are subject to NFPA 13 standards. NFPA 13 and 13R standards require a Fire Department Connection (FDC) for supplemental water from fire department pumping apparatus. Generally, the NFPA 13 standard can be achieved with a 4" fire service water meter and the 13R standard with a 2" combination domestic/fire service water meter[6]. New fire service connections 2" in diameter or greater are also subject to San Francisco Public Utilities Commission (SFPUC) requirements, which include a hydraulic analysis by SFPUC to determine if the water distribution system has sufficient capacity to support the new fire service connection.

NFPA Standards for Locations within Buildings

NFPA recommends that sprinklers be installed in all occupied spaces in order for the sprinklers to effectively protect life and property. According to NFPA standards for high-rise buildings, sprinklers should only be omitted in non-combustible concealed spaces. According to NFPA standards for single- and two-family houses, sprinklers should only be omitted in attics, concealed spaces not intended for storage or living space, or small closets and bathrooms.

Current San Francisco Residential Sprinkler Requirements

Sprinkler requirements are generally governed by the building and fire code provisions enacted at the time a building's construction or alteration permit is finalized. However, ordinances that amended the Building, Fire, and Housing Codes have required the retroactive installation of sprinkler systems in specific types of buildings and when a building's use changes.

While new apartment construction requires installation of sprinklers in all units of the building, building owners of existing apartment buildings are only required to install sprinklers under certain circumstances. Table 6 below summarizes the sprinkler installation requirements for apartment buildings constructed prior to 1970.

[6] A 4" fire service meter can provide up to 1,000 gallons per minute depending on the water pressure available. A 2" combination fire service meter can handle a maximum of 160 gallons per minute.

Table 6: Fire Sprinkler Requirements for Apartment Buildings Built Before 1970

Building Type	Fire Sprinkler Requirement
Five or more units	Storage area
Four or less stories with garbage chutes	Highest hopper inlet and at the discharge end
Five or more stories with garbage chutes	Highest hopper inlet, at the discharge end, and at every hopper inlet on each floor
Any with garbage rooms	Garbage room
Any with laundry chutes/linen rooms	Laundry chute/linen room
Any with dead-end corridors	If a three-quarter-hour opening protector is not provided at an exit door on a dead-end corridor more than 20 feet deep, sprinklers are required in the dead-end corridor and the other side of the exit door

Source: San Francisco Housing Code Sections 904(a), 906, and 801(a)(1)

If an existing apartment building is modified, the property owner must install sprinklers:

- on the first floor if a unit is added to the first floor of a building not more than three stories,
- in the modified area only if a new unit is not located on the first floor of a building not more than three stories,
- in the modified area only if no basements are converted, stories added, or changes to the building envelope,
- in all units if a basement is converted to habitable use in a four-story building,
- in all units if the building envelope is changed in a four-story or higher building, or
- in all units if a story is added to a three-story building.

The Building, Fire, and Housing Codes contain the following provisions for commercial and residential buildings, including tourist and SRO hotels.

High-Rise Buildings

Ordinance 377-93 passed in 1993 required that all high-rise buildings in the City install sprinkler systems within a 12-year period, by February 15, 2006. While tourist hotels and mixed-use occupancy buildings where occupancy is temporary must install sprinkler systems, apartments and condominiums are not required to install sprinkler systems. Qualified historical buildings are also not required to install sprinklers. The sprinkler systems installed in commercial high-rise

buildings, tourist hotels, and mixed-use/temporary occupancy buildings as a result of this ordinance must meet the NFPA 13 standard.

SRO Hotels

As of October 2001, every residential SRO hotel containing 20 or more guest rooms is required to maintain an approved automatic sprinkler system.

Tourist Hotels

All public areas of tourist hotels are required to have approved sprinklers. Public areas include: lobby areas, ballrooms, meeting rooms, restaurants, bars and cocktail lounges, night clubs, retail shops, and corridors.

Basements and Garbage Chutes in Residential Buildings

In apartment houses and hotels, any compartment or room in a basement that contains more than 1,800 square feet of floor area, or any compartment or room in such a building used for storing or using combustible or flammable materials, must have an approved sprinkler system.

Garbage chutes in buildings with four stories or less, except in dwellings, must have sprinklers at the discharge end of the chute and immediately above the top of the highest hopper inlet. All existing garbage chutes within buildings five or more stories must have sprinklers at every hopper inlet, in addition to having sprinklers at the discharge end of the chute and above the highest hopper inlet. All laundry chutes and garbage, trash, and soiled linen rooms or compartments, except in dwellings, must have sprinklers.

New Residential Buildings

Since 2008, newly constructed residential buildings intended for permanent occupancy are required to have approved sprinkler systems. Apartment buildings (three or more units) are required to have sprinklers that meet a minimum of NFPA 13 standards. One- and two-unit residential buildings are required to meet a minimum of NFPA 13D standards. Backflow prevention devices are required for all sprinkler systems.

Modified Residential Buildings

Sprinkler installation throughout a residential building is only required when a basement is converted to a habitable space, or when a vertical addition is permitted. Otherwise, sprinklers are only required in the areas where modifications are made in multi-unit residential buildings (e.g., adding a unit). When an existing building changes its use to residential occupancy, full sprinkler coverage is required.

Presence of Sprinklers in Existing Buildings

No City department maintains comprehensive records on City buildings. The Department of Building Inspection's (DBI's) data management system only has information about buildings built after 1960, which makes up only about one-quarter of the City's residential buildings. According to the Census Bureau, approximately 75 percent of residential units in the City were built prior to 1960, and the characteristics of buildings built before 1960 are likely different than more recent construction, so the available data is an incomplete and a non-representative sample of residential buildings in the City.

DBI's data management system does not maintain complete data on construction type. Based on the available data, of the properties with construction type specified, 93 percent, or 8,663 buildings, are wood-framed; however, 48 percent of properties are missing a value for construction type.

DBI's data management system also does not maintain data on sprinkler installation. Current code requires sprinklers in garbage chutes and garbage rooms, laundry chutes and rooms, basement compartments greater than 1,800 square feet, certain storage areas, and dead-end corridors. We were not able to verify the presence of sprinklers in residential buildings because DBI's data management system is missing entries on sprinkler status for buildings in the City.

Rent-Controlled Buildings

DBI's data management system does not identify if buildings are rent-controlled. Because the available information only includes buildings built after 1960 and rent control applies to multi-unit residential properties occupied prior to 1979, we cannot accurately report on rent-controlled properties.

Twenty-three percent, or 4,202, of the buildings in the available database are potentially subject to rent control because they were built prior to 1979 and are multi-unit residences. Rental status of the buildings is not known, and this figure understates the number of rent-controlled buildings in the City since 75 percent of the residential units in the City were built prior to 1960.

Of the 252 two-alarm or greater fires that occurred since July 2004, 100 fires (or 40 percent) occurred in rent-controlled buildings.

Approximately 87 percent of the two-alarm or greater fires in the City since July 2004 occurred in wood-framed buildings. Of the fires that occurred in rent-controlled buildings, 87 percent were in wood-framed buildings. The available data does not indicate if wood-framed buildings are more likely to catch fire, or if the greater number of fires in wood-framed buildings was due to the prevalence of this building type. However, wood is a more combustible material than some other building materials. Also, because the DBI data management system does not maintain data on sprinkler installation, we are not able to determine if rent-

controlled buildings have sprinklers, or if the two-alarm or greater fires occurred in rent-controlled buildings that have sprinklers.

Sprinkler Retrofit Cost Estimates

Costs to Property Owners and Tenants

According to the Fire Safety Task Force's January 2016 report, installing sprinklers in existing apartment buildings would require new costs to upgrade existing fire alarm systems, increase water connection and flow capacity, install backflow prevention, and potentially run new pipes in the building walls and ceilings. According to the report, property owners are concerned with the expense of retroactively installing sprinkler systems to existing buildings and the cost to relocate tenants during installation.

Under San Francisco's Residential Rent Stabilization and Arbitration Ordinance, the property owners can pass through the costs of sprinkler installation to the tenants, up to 10 percent of the base rent. According to the Task Force's January 2016 report, tenants are concerned with the potential pass-through of the costs and the compensation paid for relocation.

Components of Sprinkler Installation Costs

Installation of Sprinkler Heads

The estimated cost for installing a sprinkler system can be determined by multiplying the number of sprinkler heads needed by $514.62. The cost per sprinkler head estimate includes planning, labor, and materials costs for a typical three- or four-story building with exposed plumbing[7].

Water Service Connection

Additional costs are incurred if the building requires a new, larger water meter to connect to the underground water main line and a Fire Department Connection that can accommodate the water requirements for a sprinkler system. A 2" combination domestic/fire service meter can handle a maximum of 160 gallons per minute and is suitable for meeting NFPA 13R standards. A 4" fire service meter can provide up to 1,000 gallons per minute, depending on the water pressure available, and is suitable for meeting NFPA 13 standards.

[7] This dollar figure per sprinkler is derived by dividing the average cost of recent sprinkler installations by the total number of sprinklers, regardless of whether they were installed under NFPA 13 or 13R standards. Installations conducted under NFPA 13R standards are estimated to be less costly than those completed under the NFPA 13 standards. According to the Fire Safety Task Force, the cost of running new pipe inside walls and ceilings would at least double the estimated cost per sprinkler head.

The estimated cost of installing a 4" fire service water meter is $24,760, and the estimated cost of installing a 2" combination water meter is $13,180. The 2" combination water meter allows for domestic water use the majority of the time in a building, and switches over to providing water for the sprinklers in the case of a fire. The meter installation cost estimates include the cost of labor, equipment, materials, and supplies for excavating, plating, piping, backfill, and pavement restoration from the tap into the main, up to and including the installation of the water meter and meter box.

Other Cost Components

Because the water used in fire sprinkler systems is from the potable water supply, backflow preventers are necessary to keep the water that flows into a sprinkler system from flowing back and potentially contaminating the drinking water supply after sitting stagnant in the system for a long time. According to the Fire Safety Task Force, backflow prevention devices cost approximately $1,500.

There is an additional $2,200 paving cost for trenches on streets that are under a Paving Moratorium, and a $2,000 additional cost for trenches in designated Special Streets.

Table 7 below lists the component costs that may be necessary for installation of sprinklers in a residential building.

Table 7: Component Costs for Residential Sprinkler Installation

Component	Cost
Sprinkler Head (x1)	$514.62
Backflow Prevention Device	$1,500
2" Combination Water Meter	$13,180
4" Fire Service Water Meter	$24,760
Trenching on streets with Paving Moratorium	$2,200
Trenching on Special Streets	$2,000

Source: DBI, PUC, Fire Safety Task Force

Table 8 below gives the estimated costs to install sprinklers in four types of existing buildings: 1) a single-family residence; 2) a three-unit, three-story residential building; 3) a 16-unit, four-story residential building with studio and one-bedroom apartments; and 4) a 16-unit, five-story residential building with larger apartments and garage space.

Table 8: Sprinkler Installation Cost Estimates

	Square Feet (includes basement, garage, common area)	NFPA Standard	Number of Sprinklers	Base Cost [a]	Extensive Retrofit [b]
Single Family	1,800	13D	23	$11,579	$23,157
Three-Unit	4,895	13R (2" water meter)	61	$46,167	$77,654
16-Unit (studio and one-bedroom apartments)	13,440	13 (4" water meter)	168	$112,713	$199,166
16-Unit (two- or more bedroom apartments)	42,600	13 (4" water meter)	533	$300,285	$574,309

Source: Budget and Legislative Analyst Estimates

[a] The estimates include the costs of (1) water meter connection, (2) backflow device, and (3) sprinkler installation every 80 square feet, based on the metric provided by SFFD.

[b] Running new pipes in the walls or ceilings could double the cost of installing sprinkler heads.

The actual costs to install sprinklers could be significantly higher for any building that requires:

- Compliance with Paving Moratorium or Special Street designations, increasing the cost by approximately $2,000 to $2,200.
- Special connection of the fire service water meter to the water service if the service connection is located far away, on a busy street or street requiring significant restoration, the water main is insufficient in size, or other factors. According to the Fire Safety Task Force report, such special connections could increase the connection cost from $24,760 to as high as $150,000 in extreme cases.
- Addition of a fire pump in rate cases in tall buildings at higher elevations, according to the Fire Safety Task Force report, could cost an estimated $75,000.
- Upgrade of existing fire alarm systems.

Property owners would have additional permitting costs to cover City expenses for plan checks, inspections, and other expenses.

Potential Insurance Premium Savings

Property owners could potentially save on property insurance premiums by installing sprinklers. One study in 2008 by the Fire Protection Research Foundation found that property insurance companies in California gave 10 percent discounts for installing sprinklers in residential buildings.[8] Therefore, if the owner of a three-unit residential building paid $2,400 per year in property insurance, they would receive an annual discount of $240.

Other Cities' Requirements to Install Sprinklers in Existing Buildings

The San Francisco Task Force did not make specific recommendations in their January 2016 report to require sprinkler retrofit of existing apartment buildings, citing the complexity and costs of retrofitting. We did not identify other cities that required comprehensive fire sprinkler retrofit of existing apartment buildings.[9, 10] According to fire marshals and fire prevention officers, as well as officials from the National Fire Sprinkler Association and the fire sprinkler industry that we interviewed or surveyed for this report, requirements to install sprinklers in existing apartment buildings are uncommon, unless the building is undergoing renovation, and generally opposed by organizations representing building owners. For example, in August 2013, the Illinois State Fire Marshal withdrew a proposed change to the State Fire Code that would have required

[8] The report - *Home Fire Sprinkler Cost Assessment*, Fire Protection Research Foundation, September 2008 - found that three large insurers with 50 percent of market share gave premium discounts of 10 percent to install sprinklers in residential buildings.

[9] In the process of identifying cities with mandatory sprinkler retrofit requirements for apartment buildings, we surveyed or interviewed fire marshals responsible for the following California jurisdictions: Eureka, Fremont, Glendale, Grass Valley, Huntington Beach, Morgan Hill, Rancho Cucamonga, Redwood City, Santa Barbara, Tiburon, Los Angeles County, and Santa Clara County (cities of Campbell, Cupertino, Los Altos, Los Altos Hills, Los Gatos, Monte Sereno, Saratoga and the unincorporated areas of Santa Clara County). We corresponded with fire marshals in Juneau, Alaska and Boston, Massachusetts and reviewed Fire, Residential, and Building Codes from a number of states and other cities. Additionally, we interviewed fire protection consultants and engineers involved with writing the International Fire Code, the former fire marshal for the State of California, representatives of the NFPA, the Fire Sprinkler Initiative, the National Fire Sprinkler Association, and the Northern and Southern California Fire Prevention Officers Associations.

[10] According to a 2007 report by the National Fire Sprinkler Association, a survey in 1992 found several cities with retrofit ordinances pertaining to high-rise apartment buildings. Our follow up for two cities in the 1992 survey found that (1) the City of San Jose, California adopted an ordinance to require installation of sprinklers in existing apartment buildings when the building increased the square footage or the nature of occupancy changed; and (2) the City of Boulder, Colorado adopted the International Fire Code requirements to install sprinklers in new high-rise buildings.

Chicago residential high rises built before 1975 to install fire sprinklers in the face of opposition from residents.[11]

Sprinkler Retrofit in Renovated Buildings

We identified several cities that have fire sprinkler retrofit requirements in existing apartment buildings undergoing renovation.[12] Generally, sprinkler systems in renovated apartment buildings must meet the NFPA 13R standard. Sprinkler installation requirements typically involve remodels or renovations that exceed 50 percent of existing square footage or increase the building beyond a certain square footage threshold. In some instances the threshold is cumulative over the life of the building. Some ordinances require retrofitting after substantial fire damage. Examples of sprinkler installation requirements in renovated buildings include the cities of Los Angeles, Fremont, and Glendale, California, as noted below.

Los Angeles' Dorothy Mae Ordinance

On September 4, 1982, a pre-dawn fire killed 25 people and injured 36 in the four-story Dorothy Mae Apartments located in a low-income area on Sunset Boulevard in Los Angeles. Victims were almost all Hispanic living in one-room apartments, and many were related. It is the deadliest residential fire in Los Angeles history. Arson was the cause.

The building was a center corridor-type structure in which entrance and exit are via a center hallway with apartments lining each side. During a fire, the center corridor is the only means of escape on the upper floors, but the corridor functions in effect as a "horizontal chimney" as gases accumulate in the hallway ceiling area and ignite when the gas flash point temperature is reached.

In the Dorothy Mae fire, the fire moved down corridors past open fire doors designed to keep fires from spreading. Most victims panicked and ran into the burning hallways. Fire officials at the time reported that if residents had stayed in their rooms, they would have survived since all but two of the apartments were virtually untouched. The building had smoke detectors.

The "Dorothy Mae Ordinance" effective June 20, 1984 required all pre-1943 residential buildings of three or more stories to install automatic sprinklers in common areas, inside entry doors in each residential unit, and fire alarm systems.

[11] http://www.rrstar.com/x1465124663/Illinois-state-fire-marshal-withdraws-sprinkler-mandate-proposal

[12] Some of the California jurisdictions requiring sprinkler installation in renovated buildings include: Fresno (when additions exceed 25 percent of existing square footage), Huntington Beach, Santa Barbara, Tiburon, Los Altos, Fremont, Campbell, Cupertino, Los Gatos, Monte Sereno, Saratoga, and unincorporated areas of Santa Clara County.

Fremont Fire Sprinkler Ordinances 2344 and 2339

On June 22, 1999, the City of Fremont adopted Ordinance Nos. 2344 and 2339, which required apartment buildings of two stories or more with central corridors to install fire sprinklers in the corridors and apartments. As in Los Angeles, these ordinances were motivated by a series of fires in Dorothy Mae-type apartment buildings.

According to the City of Fremont's Fire Marshal, there were about 20 two-story apartment complexes to which the ordinances applied. The goal of the ordinances was primarily to keep the corridors in these buildings free of fire to allow escape in the event of a fire. The Fire Marshal reported that, during his tenure, other buildings that were missed during the initial required noticing of building owners had been identified. Owners of these buildings were given a year to submit plans and three years to conform. The ordinances withstood legal challenge by the California Apartment Association.[13]

The City of Glendale's Fire Sprinkler Requirements

The City of Glendale's local fire sprinkler ordinance exceeds California Fire Code fire sprinkler requirements. The city has a population of approximately 200,000 and residential buildings are a mixture of older wood-framed buildings and new construction.

According to the Fire Marshal, Glendale was an early adopter of a mandatory fire sprinkler ordinance for new construction. Beginning 25 years ago, Glendale, required the installation of an automatic fire sprinkler system in existing residential and commercial buildings four or more stories in height. Parking structures are exempt from this requirement. All such apartment buildings must be equipped with a complete automatic fire sprinkler system throughout the entirety of the building, including inside individual dwelling units, hallways, stairwells, laundry rooms, garages, etc.

The only multi-unit residential buildings that are not required to have fire sprinklers are small apartment buildings three stories or less in height, which were constructed prior to the current code requirements for automatic fire sprinkler systems. For these buildings, there is no mandatory retrofit requirement for fire sprinklers unless the owner seeks permits for an addition or remodel that triggers the requirement for installation of fire sprinklers.

[13] Court of Appeal, First District, California. California Apartment Association et al., Plaintiffs and Appellants, v. City of Fremont, Defendant and Respondent. No. A095016. Decided: April 12, 2002

Redwood City Retroactive Fire Sprinkler and Rent Stabilization Loan Forgiveness Ordinances

Redwood City, California was the only city that we identified with an incentive program to install sprinklers in existing buildings. On May 18, 2015, after large fires in 2013 destroyed 147 units in two apartment buildings, the City Council of Redwood City adopted an ordinance requiring apartment buildings built before July 1, 1989, with four or more units to install life safety systems including fire sprinklers by 2020.[14]

To encourage installation before the 2020 deadline, the City Council authorized a five-year pilot loan forgiveness program for property owners who install the life safety system including sprinklers before 2020. In exchange for the forgivable loan, property owners must limit rent increases. The program's main features are as follows:

- Loans may not exceed $5.00 per square foot of the building; the Fire Marshal estimated the maximum loan amount to be $20,000.
- Borrowers may not increase rent by more than 5 percent or the increase in the Consumer Price Index, whichever is less, in any 12-month period during the term of the loan.
- Borrowers must demonstrate that no rent increase in the 12 months preceding their application, and continuing through the date they receive a loan, has been greater than the average increases on a percentage basis than during the five-year period preceding their loan application.
- Tenants may not be displaced during installation.

The Redwood City Fire Marshal reported that some property owners had chosen to install sprinklers but forgo the loan program and commitment to rent stabilization while "about two dozen" had expressed an interest in the program.

The Redwood City program could not be adapted to San Francisco because the ordinance and program is based on California Fire Code sections that allow domestic water supply and limited area fire sprinkler systems, rather than specialized water supply connections required by NFPA 13 and 13R standards. San Francisco's municipal codes require that multi-unit residential buildings meet NFPA 13 and 13R standards.

[14] Section 12.18 of Redwood City's Fire Code

Alternatives and Policy Options for Sprinkler Retrofit in Existing Apartment Buildings

San Francisco's requirements to install sprinklers in apartment buildings conform to NFPA standards and are comparable to other cities. While NFPA recommends sprinkler installation to protect lives and properties, we did not identify any cities that require sprinkler installation in existing apartment buildings except during renovation. The deterrent to requiring installation of sprinklers in existing buildings is cost and impact to the residents.

Expanded Smoke Detector Requirements

As a first step, the Board of Supervisors could expand requirements to install hard-wired smoke detectors in existing apartment buildings. Currently, property owners are only required to install battery-operated, and not hard-wired, smoke detectors in existing buildings if the buildings were not previously wired for smoke detectors. According to a former San Francisco Fire Marshal, hard-wired alarms are safer because tenants may remove the batteries from battery-operated alarms but are unlikely to disable a hard-wired alarm. While property owners would incur costs to upgrade electrical systems to install hard-wired smoke detectors, the costs would likely be less than to install sprinklers.[15]

Deterrents to Installation of Fire Sprinklers in Existing Apartment Buildings

The Fire Safety Task Force's January 2016 report outlined the problems in installing sprinklers in existing buildings, including the costs to property owners and disruption to tenants.

Cost Impacts

Our cost estimates for sprinkler retrofit ranged from $46,000 for a three-unit building to $113,000 to $300,000 for a 16-unit building. Costs would be higher if apartment walls needed to be opened or tenants relocated during construction.

San Francisco does not have existing loan programs or sources of funds to assist property owners with the costs of sprinkler installation. Property owners would have the option of obtaining private loans, including equity lines of credit that have lower interest rates than personal loans, to pay for the costs of sprinkler

[15] Beginning in 2014, State law required that all battery-operated smoke detectors have a non-replaceable battery that lasts 10 years (although existing smoke detectors do not need to be replaced unless inoperable or the owners obtains a building permit for work of $1,000 or more). Beginning in 2015, State law required that all smoke detectors display the date of installation and incorporate "hush" features. Beginning in 2016, owners of rental units were required to install smoke detectors in each bedroom or other sleeping areas. Beginning in 2017, San Francisco municipal code requires residential property owners to provide tenants a written notice regarding smoke alarm requirements.

installation. The Board of Supervisors could consider implementing a loan program, similar to the seismic safety loan program, if the City were to require installation of sprinklers in existing apartment buildings.

Tenant Displacement

The extent of inconvenience to or displacement of tenants during installation of sprinklers would depend on (1) whether the system installed meets one of the national standards (NFPA 13 or 13R[16]) or is a modified version such as the Dorothy Mae systems described in this report, and (2) how the piping and sprinkler heads are installed in individual units.

Installation in common areas (lobby, corridor/hallway, stairway, laundry room, equipment areas, garages/parking area) can occur without displacing occupants using either standard. Systems installed according to NFPA standards in four-story or higher buildings would have a dedicated water source separate from the domestic water supply so there should be limited disruption of existing water service.

However, within individual apartments, the complexity of the work and extent of inconvenience to tenants will depend on whether the piping is hidden from view behind walls and in ceilings or exposed. Tenants may be able to remain in their apartments if external piping is installed but may require relocation if walls and ceilings are opened to install piping. Tenants may also be concerned with security of household items and furnishings and cosmetic damage.

Considerations and Priorities for Installation of Sprinklers in Existing Apartment Buildings

Policies to require sprinkler installation in existing apartment buildings should (1) define the universe of eligible apartment buildings, and (2) establish priorities for sprinkler installation. Consideration to expand requirements to install sprinklers in existing apartment buildings should incorporate the Fire Safety Task Force's recommendations, including obtaining more specific information regarding the causes of fires and how fire safety systems and construction types perform so that expanded requirements could target the highest-risk buildings.

Prioritizing High-Risk Buildings

The Fire Department's Bureau of Fire Prevention and Investigation should develop objective criteria for assessing fire risks and identifying buildings that pose the highest fire-safety risk, including buildings that have repeated failure to abate fire safety violations. The City should prioritize high-risk buildings for a retroactive sprinkler requirement.

[16] If the City abides by NFPA sprinkler standards, buildings of four stories or more would have to install sprinklers according to the more stringent and more expensive NFPA 13 standard.

Reducing the Risk of Tenant Displacement

Avoiding tenant displacement may be difficult if the work to install sprinklers in existing apartment buildings is extensive, especially if walls and ceilings are opened to install piping. The risk to tenants could be reduced by:

- Implementing a program similar to the City of Los Angeles' "Dorothy Mae Ordinance" in which automatic sprinklers are installed in all existing apartment buildings of three stories or more in common areas and inside entry doors in each residential unit; and/or
- Phasing in sprinkler installation in residential units between tenants. While phasing in sprinkler installation could increase sprinkler installation costs, tenant relocation costs would be avoided.

If the City were to adopt policies to require installation of sprinklers in occupied residential units of existing apartment buildings, any proposed policy should (1) establish mechanisms to relocate tenants and responsibility to pay relocation costs, and (2) provide for the return of tenants to their units once installation is completed.

Other Considerations

Expanded requirements also need to consider:

- Sufficiency of water supply to support extensive sprinkler installation;
- Capacity of the Department of Building Inspection, Planning Department and Fire Department to permit and inspect new sprinkler systems; and
- Availability of contactors to install sprinkler systems, including pre-qualification by the Department of Building Inspection and Fire Department of fire protection contractors to manage quality and streamline plan review, inspections, and final approvals.

Appendix I

San Francisco Building Code

Chapter 34, Section 3414.27: Automatic Sprinkler System – Existing High-Rise Buildings

General. Regardless of any other provisions of this code, every existing high-rise building as defined in Section 403.11.1 shall be provided with an approved automatic sprinkler system conforming to NFPA 13. Existing high-rise buildings that are also qualified historical buildings as defined in California Health and Safety Code 18950 shall be provided with an approved automatic fire sprinkler system when and as required by the State Historical Building Code. The effective date of these requirements shall be February 15, 1994.

Exceptions:

1) An apartment house, condominium, or other building used as a Group R, Division 2 Occupancy as defined in this code excluding tourist hotels as defined in Section 41.4(r) of the San Francisco Administrative Code.
2) A mixed-used occupancy building containing a Group R, Division 1 or Group 2, Division 2 Occupancy.

3414.27.6 Authority of Building Official. The Building Official, in consultation with the San Francisco Fire Marshal, may approve modifications and alternate methods and materials when it is clearly evident that a reasonable degree of fire safety is provided. In such cases, the Building Official may:

1. Consider alternative protection based on nationally recognized standards, principles and tests, and generally recognized and well-established methods of fire protection;
2. Waive specific individual requirements if it can be shown that such requirements are not physically possible, require disproportionate effort or pose an undue hardship with little increase in life safety and that a practical alternate cannot be provided; and
3. Grant necessary extensions of time when it can be shown that the specific time periods are not physically practical or pose an undue hardship. The granting of an extension of time for compliance may be approved by the Building Official based on the showing of good cause and on approval of an acceptable, systematic, progressive plan of correction.

San Francisco Fire Code

Chapter 11, Section 3.5.1: Automatic Sprinkler System for Existing SRO Hotel Buildings

Every residential hotel building existing on October 16, 2001, that contains twenty (20) or more guest rooms, as defined in the California Building Code, shall provide and maintain an automatic sprinkler system installed to comply with San Francisco Ordinance 170-02 throughout the residential occupancy, including accessory areas. For purposes of this section, "Residential Hotel" means each and every hotel for which a Certificate of Use for any residential units has been issued pursuant to San Francisco Administrative Code Chapter 41. Any Residential Hotel that does not maintain an

installed automatic sprinkler system throughout the residential occupancy is out of compliance and subject to immediate code enforcement action. The owner shall maintain the sprinkler system in accordance with Title 19 of the California Code of Regulations.

Chapter 11, Section 3.5.2: Automatic Sprinkler System for Existing High-Rise Buildings

All existing high-rise buildings shall maintain an automatic sprinkler system installed to comply with San Francisco Ordinance 377-93.

Exceptions

1) Qualified historical buildings as defined in the California Health and Safety Code Section 18950.
2) Apartment houses, condominiums, or other R-2 occupancies.
3) A mixed-used occupancy building containing an R-2 Occupancy.

Chapter 11, Section 3.5.3: Automatic Sprinkler System for Existing Hotels

All hotels described in San Francisco Ordinance 319-86 shall maintain an automatic sprinkler system installed to comply with San Francisco Ordinance 319-86 throughout all common areas of the hotel. Any existing hotel that does not provide an automatic sprinkler system in accordance with the ordinance is out of compliance and subject to immediate code enforcement action. The owner shall maintain the sprinkler system in accordance with Title 19 of the California Code of Regulations.

San Francisco Housing Code

Chapter 8, Section 801: Exits, Stairs and Occupant Load

(a) Exit facilities for buildings constructed, altered or converted after July 26, 1958 shall comply with the codes in effect at the time of construction, alteration or conversion, or the provisions of Chapter 10 of the Building Code, whichever is the less restrictive, as is applicable to that occupancy.

Exit facilities for buildings constructed, altered or converted prior to July 26, 1958 shall meet the following minimum requirements listed below, or where less than two exits are required shall comply with the provisions of Chapter 1 of the Building Code, including all requirements of the current Building Code for fire resistance and exits, whichever is the less restrictive:

Each of the following buildings now in existence shall be provided with access for each dwelling unit or guest room to two exits which shall be accessible either directly or through a public hallway and shall be so located that if access to one be denied, the other shall be available:

(1) In apartment houses, hotels (and two-family dwellings per Section 3 1 0.4 of the Building Code).

Where exits are arranged so that one exit must be passed to get to the other, intervening doorways between any exit doorway on a dead-end corridor more than 20 feet in depth and the main exit corridor shall be provided with a

three-quarter-hour opening protector or a sprinkler head located on the room side of the doorways as well as in the dead-end corridor.

Chapter 9, Section 904: Automatic Sprinkler System

Where required: In any apartment house or hotel, any compartment or room in the basement containing more than 1,800 square feet of floor area, or any compartment or room in such a building used for storing or using combustible or flammable materials, shall be equipped with an automatic sprinkler system of a type designed and installed according to the provisions of Chapter 9 of the Building Code. Automatic sprinkler systems designed and installed according to the provisions of Chapter 9 of the Building Code shall be furnished and installed in all hotels as required by this Code.
Exceptions:

1) Boiler rooms, central heating rooms, and bank vaults are excluded from this chapter.
2) Compartments or rooms in the basement of apartment houses containing four or less dwelling units, provided that there are no mattresses, upholstered furniture, or loose storage contained therein, are excluded from this chapter.

Residential Hotels. An automatic sprinkler system, designed in accordance with NFPA, shall be installed throughout the residential occupancy of every residential hotel building existing on October 16, 2001, and which contains 20 or more guest rooms, as defined in the California Building Code. "Residential hotel" for purposes of this subsection shall mean each and every hotel for which a certificate of use for any residential units has been issued pursuant to San Francisco Administrative Code Chapter 41. The design criteria for the installation of the sprinkler system shall be approved by the San Francisco Fire Department and shall comply with NFPA 13.

Chapter 9, Section 906: Automatic Sprinklers

Automatic sprinklers shall be installed in:

(1) All existing garbage chutes within buildings four stories or less, except in dwellings, at the discharge end of the chute and immediately above the top of the highest hopper inlet, not to exceed 35 feet between heads;
(2) All existing garbage chutes within buildings five or more stories in addition to the requirements in item (1) of this section at every hopper inlet. If the hopper inlet opens directly into a public hall without an intervening door, a sprinkler head is to be installed on every floor above each hopper inlet;
(3) All laundry chutes except for dwellings;
(4) All garbage, trash and soiled linen rooms or compartments except in dwellings. Total number to be determined by area. The sprinkler head is to be set for 135 degrees;
(5) In all public areas of hotels not otherwise required to be sprinklered by this code. For purposes of this Section, the term "public areas" shall be defined to include only the following types of areas:
    (i) Lobby areas,
    (ii) Ballrooms,

(iii) Meeting rooms (excepting, however, those rooms which are used as meeting rooms on a temporary basis),

(iv) Restaurants and other areas generally used for the purpose of serving food to the public,

(v) Bars and cocktail lounges,

(vi) Night clubs and similar areas,

(vii) Retail shops and similar areas (excepting, however, those retail shops and similar areas which are separated from the rest of the hotel by a fire-rated wall (such wall may contain openings as long as each opening is the equivalent of a one-hour fire-rate assembly) and which (a) opens directly to the exterior of the building through a sprinkler protected corridor not more than 25 feet from the street and having a token sprinkler head on the retail shop side of the opening into such corridor), and

(viii) Corridors connecting any two or more public areas as defined in this Section.

Appendix II

Summary of Cities with Apartment Building Retrofit Requirements

Fire Department	Apartment Building Retrofit Requirements
Huntington Beach	Buildings over 5,000 square feet undergoing a tenant improvement, or that will be over 5,000 due to the tenant improvement, with one of the following conditions: 1. Occupancy/tenant space undergoing tenant improvement where the square footage of the space is being increased. 2. Occupancy/tenant space where there is a change in occupancy classification to an assembly, educational, institutional, hazardous, or residential use. 3. Occupancy/tenant space where the entire roof structure is to be removed during the improvement. 4. Assembly occupancy that increases the maximum occupant load to exceed 299 persons.
Santa Barbara	When cumulative remodels exceed 50% of the gross square footage (75% for single family homes, duplexes and townhouses).
City of Los Altos	When additions are made that are 50% or more of existing floor area.
Morgan Hill	When additions are made that increase the building area to more than 3,600 square feet.
Tiburon	When cumulative remodels exceed 50% of square footage.
Santa Clara County: Campbell, Cupertino, Los Gatos, Monte Sereno, Saratoga and unincorporated Santa Clara County	Additions that increase the building area to more than 3,600 square feet.
Glendale	Existing apartment buildings four or more stories in height.
Los Angeles	1984 "Dorothy Mae" ordinance required fire sprinklers in pre-1943 buildings three or more stories in height.
Fremont	All existing central corridor ("Dorothy Mae Style") hotel and apartment buildings two stories or more in height containing 10 or more dwelling units.
Redwood City	Pre July 1, 1989 multi-unit buildings with four or more units.