



Memorandum

TO: PUBLIC SAFETY, FINANCE &
STRATEGIC SUPPORT COMMITTEE

FROM: Robert Sapien, Jr.

SUBJECT: FIREFIGHTER SAFETY SYSTEMS
IN HIGH RISE BUILDINGS REPORT

DATE: August 10, 2020

Approved

Date

8-11-20

RECOMMENDATION

Accept a report on firefighter safety systems in high rise buildings comparing Firefighter Breathing Air Replenishment Systems and fire-rated elevators, including consideration of any changes to the 2019 California Fire Code and/or Fire Department policies, procedures, and equipment.

BACKGROUND

Firefighting in structures presents a respiratory hazard to firefighters, and fires beyond the incipient stage create environments that are immediately dangerous to life and health (IDLH). Because of this, firefighters are highly dependent on self-contained breathing apparatus (SCBA) which provide portable breathable air and consist of a harness, face mask, and air cylinder. To refill spent cylinders, the Fire Department maintains a fixed air cylinder filling facility and two mobile Breathing Air Support Units (BASU).

Firefighter Breathing Air Replenishment Systems (FBARS), also called Firefighter Air Replenishment Systems (FARS), are systems of connection manifolds, distribution piping, and filling cabinets which deliver breathable air for replenishment of depleted SCBA cylinders in high-rise buildings and other structures where firefighting operations may be occurring some distance from emergency vehicles. FBARS are supplied by the Department via BASU from the street access level.

The City of San José requires FBARS in buildings with two or more floors underground, tunnels more than five hundred feet in length, any building where the fire apparatus access point is located more than one hundred fifty feet from the nearest entrance to the building, and high-rise buildings as defined by the Fire Code. Local jurisdictions are authorized, but not required, to impose a FBARS requirement. High-rise buildings are defined as those having floors used for

human occupancy exceeding seventy-five feet (75') above the lowest level of the fire department vehicular or personnel access¹.

On January 25, 2005, San José City Council acted to amend the San José Municipal Code “to require the installation of Firefighter breathing air systems in high rise buildings².” On October 26, 2010, as part of the local adoption of the 2010 California Building Standards, action was taken to allow a designated Firefighter elevator as an alternative to FBARS in high-rise buildings. On December 3, 2013, Council revised the municipal code to remove the alternative that allowed builders to install a designated firefighter elevator as an alternative to FBARS. Since this removal of the firefighter elevator alternative, FBARS has been required for all newly constructed high-rise buildings.

On October 21, 2019, Council directed “the City Manager to engage with the Fire Chief and Fire Department to analyze whether an alternative to FBAR’s – such as fire-rated elevators – will provide at least equal or better safety to firefighters and residents in high-rise buildings.³”

Most of San José’s existing high-rise buildings preceded FBARS installation requirements. Currently, 11 high-rise buildings are equipped with FBARS. If built today, all high-rise buildings would require FBARS installations. Existing high-rise building do not require retrofitting of FBARS (Table: 2).

Table: 2

High-Rise Buildings	Number of Buildings	Average Height	FBARS
Existing	98	155 Feet	11 systems installed
Under Construction	13	215 Feet	13 systems required
Plans Submitted	39	236 Feet	39 systems required

ANALYSIS

Firefighters require a sustained source of breathable air to provide for respiratory protection as the extinguish fires in high-rise buildings. Because the number of FBARS installations are limited relative to the number of existing high-rise buildings, Department standard operating procedures (SOP) are written to assume that no systems are present. High-rise SOP require firefighters to port extra SCBA cylinders (two cylinders per firefighter) aloft to the specified tools and equipment staging area. Climbing stairs with the added weight of firefighting personal

¹ San José Municipal Code 17.12.110 - Local Amendments to the 2019 California Fire Code – Appendix L, Section L101.1:

https://library.municode.com/ca/san_jose/codes/code_of_ordinances?nodeId=TIT17BUCO_CH17.12CISAJOFICO_PT13ADAP2019CAFICO

² <https://records.sanjoseca.gov/Ordinances/ORD27341.PDF>

³ <https://sanjose.legistar.com/View.ashx?M=F&ID=7816057&GUID=5D8F0FFA-55D8-49EC-8CF9-97F49B147F79>

protective equipment (PPE) and tools and equipment is arduous and firefighters can be fatigued even before initiating fire suppression efforts. To reinforce potentially fatigued crews and ensure adequate resources are available to sustain operations in the challenging high-rise environment, the Department's high-rise response plan delivers more than 50 personnel to the scene where light smoke or sprinkler flow is detected. In circumstances where firefighting operations are extended, spent SCBA cylinders must be either refilled within the buildings where FBARS is installed, or be ported to the street level to be filled at a Breathing Air Support Unit (BASU).

The plan specifies roles and responsibilities to provide sustained movement of tools and equipment required to support firefighting operations including exchange of spent and full SCBA cylinders. This is resource intensive if achieved through building stairwell or less resource intensive via elevator if determined safe and permitted by the Incident Commander (IC).

The Department is conservative in its use of elevators because not all elevator systems are rated for excess weight of firefighting crews and equipment and protection from water, smoke, and fire. Unrated elevator systems can be unreliable under fire conditions and could fail and trap firefighters or deliver firefighters to dangerous floors in the structure. Where fire service access elevators (FSAE) are installed, the IC is more likely to authorize use where FSAE are determined to be operational.

The Department has found some challenges in FBARS operations. FBARS are dependent on timely arrival and connection of BASU. In many circumstances, BASU arrive well after first arriving emergency vehicles have been positioned and hose lines deployed to connect to fire department connections (FDC) to supply fire sprinkler and standpipe systems. The result is that BASU cannot be positioned close enough to the high-rise building to connect to the FBARS manifold until other vehicles and equipment are repositioned. This circumstance is difficult to prevent because initial arriving crews base decisions on locations of FDC, fire hydrants, building and street configuration, fire conditions, and other SOP. If the BASU connection will be delayed, the IC must decide whether to attempt to move equipment or to fill SCBA air cylinders from a distance and port them in on carts and send them aloft through stairwells or elevators.

Although distinctly different, both FBARS and FSAE can effectively support SCBA air cylinder support operations and some local agency fire codes allow FSAE in lieu of FBARS. Many California agencies do not require FBARS in any high-rise, however do require FSAE for buildings over 120 feet as specified in the California Building Code⁴.

It is important to note that both FBARS and FSAE are susceptible to failure. FBARS relies on a BASU arriving on scene and obtaining access to the connection manifold. Further, the distribution piping and filling stations (cabinets) must be intact and accessible. FSAE rely on electrical power which can fail, and that can fail mechanically. Because of this, the Department will always maintain the stairwell support option for SCBA air cylinder and equipment support.

⁴ FSAE were added to section 403.6.1 of the California Building Code (CBC) in 2010 requiring buildings with "an occupied floor more than 120 feet above the lowest level of fire department vehicle access" to provide a minimum of one fire service access elevator. In 2013, section 403.6.1 was modified to require "no fewer than two fire service elevators ... with a capacity of not less than 3500 pounds each."

Firefighter Breathing Air Replenishment System (FBARS)

FBARS received its U.S. Patent in 1996 and was added to the International Fire Code (IFC) in 2015 after receiving recommendations from the International Code Council's (ICC) Fire Code Action Committee (FCAC) and the International Association of Fire Chiefs (IAFC) Fire and Life Safety Section⁵. The use of FBARS was later added to the California Fire Code as Appendix L, allowing individual jurisdictions to require the installation of the system based on local needs.

FBARS requirements vary across western cities. Amongst the three largest cities in the Bay Area (San José, San Francisco, and Oakland), only San José requires the installation of FBARS with no alternatives.

Table 1: FBARS requirements amongst western cities

City	FBARS Required
Austin, TX	No
Berkeley, CA	No
Los Angeles, CA	No
Mountain View, CA	No
Oakland, CA	No
Palo Alto, CA	Yes
Phoenix, AZ	Yes
Portland, OR	No
Reno, NV	Yes
Sacramento, CA	Yes
San Diego, CA	No
San Francisco, CA	Yes
Seattle, WA	No
Sunnyvale, CA	Yes

The City of San Francisco has more than 180 buildings over 160 feet in height, of which 156 exceed heights greater than 240 feet. Excluding buildings under 160 feet, the average height of high-rise buildings in San Francisco is 363.42 feet averaging 28.52 floors which is approximately twice the average height of existing high-rise buildings in San José⁶. Like San José, the City of San Francisco requires the installation of FBARS in buildings 75 feet or taller; however, San Francisco allows an exception to FBARS for buildings equipped with a Fire Service Access Elevator (FSAE). For example, Salesforce Tower was constructed under these guidelines and is the San Francisco's tallest building with an overall height of 1,070 feet and 61 floors. In this case, the installation of two FSAE was permitted "in-lieu" of FBARS.

⁵ Breathing Air Replenishment U.S. Patent

<https://patentimages.storage.googleapis.com/89/6f/b5/1dd6c4edabca51/US5570685.pdf>

⁶ <https://data.sfgov.org/Housing-and-Buildings/Tall-Building-Inventory/5kya-mfst>

Fire Service Access Elevator (FSAE)

FSAEs are not a new concept; in fact, the World Trade Center attack on September 11, 2001 reignited the conversation surrounding protected elevators for egress and access. These elevators are constructed to withstand additional weight capacity and have reinforced elevator shafts that protect the elevator car from water, smoke, and fire. The protected shaft and elevator lobby provide a safe means to move people, tools, and equipment.

The use of a FSAE will require firefighters assigned to move SCBA cylinders from the BASU to the elevator lobby. This is achieved by using carts capable of carrying eight cylinders each. These carts are then placed in FSAE and sent with or without personnel to the staging location where cylinder exchange is completed. Although this operation is less labor intensive than carrying bottles in stairwells, it is dependent on the operational status of a FSAE.

Firefighters' Concerns

The Department engaged *San Jose Fire Fighters, IAFF Local 230* to discuss laborers' concerns with firefighter safety systems in high-rise buildings that may have not been articulated through the Bureau of Field Operations chain-of-command. The outcome of the discussion highlighted the following areas of concerns:

1. Fire Department Staffing: Local 230 points out that combating fires in high-rise buildings is resource intensive and expresses concerns about Department staffing levels.

Department comments: Upon recognition of heavy smoke or flame in a high-rise building, by Department SOP, a Level 3 (three alarm) high-rise response is activated. The Level 3 response includes 91 personnel, which is approximately 50% of on duty resources. An incident of this scale would challenge the Department's ability to provide timely and effective citywide coverage. Beyond a Level 3 response, the Department would need to request mutual aid assistance from other fire agencies to support firefighting operations and/or assist with citywide coverage.

2. Operational Support: Local 230 expresses concern that a reliable and effective SCBA air cylinder support system needs to be in place to ensure that firefighter safety is not compromised.

Department comments: Logistical support, including SCBA air cylinder replenishment, is critical to sustained successful high-rise firefighting operations. The Department recognizes that whether or not FBARS and/or FSAE are present in a high-rise building, SOP must provide for adequate air support. Department SOP assumes that FBARS or FSAE are not present or not functioning and sets up at all high-rise fires to bring extra air cylinders to interior staging areas, fill air cylinders at the street access level, and provide sufficient resources for stairwell support.

3. Maintenance and Training: Local 230 expresses concern for ensuring ongoing FSAE and FBARS maintenance and that the Department provide initial and recurring training for firefighters.

Department comments: Property owners are responsible for ongoing care and maintenance of FSAE and FBARS, and compliance is confirmed through recurring Bureau of Fire Prevention inspections. To effectively employ FSAE and FBARS in emergency situations, the Department must provide initial and recurring training on to all response personnel. The Department's FY 2020-2021 workplan include revision of high-rise SOP and training curriculum for delivery in 2021.

4. Firefighter Safety: Local 230 expresses concern about the physical demands that firefighters are confronted with during high-rise firefighting operations. Specifically, Local 230 has expressed concern about the weight of SCBA air cylinders.

Department comments: The Department acknowledges that firefighting in all circumstances is highly strenuous and, in some environments, like high-rise buildings, the additional burden of carrying equipment up stairwells which is physically taxing and can lead to injuries from strains, falls, and over exhaustion. Currently, the Department is evaluating options for replacement of aging SCBA equipment. During this process, the Department will also be evaluating available SCBA air cylinder to identify the most suitable to meet Department needs.

Development Community Feedback

For several years, the Department has received anecdotal feedback from the high-rise development community about FBARS and FSAE requirements. To capture current high-rise development community thoughts on these systems, the Department conducted a survey of 150 local developers, to which 23 responses were received. The intent of the survey was to assess whether previously heard anecdotal concerns could be affirmed across multiple developers and to capture any information that might better inform the Department's as it evaluated these systems. The results of three areas of inquiry are offered below.

Developers were asked to select a response best matching their overall experience in installing both FBARS and FSAE. Results are expressed in percentages and number of responses in parentheses:

<i>Overall Experience</i>	FBARS (# responses)	FSAE (# responses)
Highly satisfied	4.76% (1)	6.25% (1)
Somewhat satisfied	4.76% (1)	25% (4)
Somewhat dissatisfied	19% (4)	0% (0)
Highly dissatisfied	42.9% (9)	12.5% (2)
Not applicable	28.57% (6)	56.25% (9)

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Developers were asked to select a response best matching their overall experience in securing a competitive bid for both FBARS and FSAE. Results are expressed in percentages and number of respondents in parentheses:

<i>Competitive Bidding</i>	FBARS (# responses)	FSAE (# responses)
Highly satisfied	4.55% (1)	13.33% (2)
Somewhat satisfied	9.09% (2)	20% (3)
Somewhat dissatisfied	4.55% (1)	0% (0)
Highly dissatisfied	68.18% (15)	6.67% (1)
Not applicable	13.64% (3)	60% (9)

Developers were asked to select factors influencing their thoughts on FBARS and FSAE. Results are expressed in percentages and number of times a factor was selected in parentheses:

	FBARS (# of selected)	FSAE (# of selected)
Cost	22.09% (19)	23.73% (14)
Vendor options	22.09% (19)	15.25% (9)
Equipment availability	15.12% (13)	11.86% (7)
Design considerations	17.44% (15)	28.81% (17)
Firefighter safety	6.98% (6)	11.86% (7)
Confidence in system effectiveness	16.28% (14)	8.47% (5)

Information gathered through the survey from the targeted high-rise development community did not result in information that influenced the Department's evaluation of FBARS and FSAE. The last question posed in the survey offered an opportunity for respondents to add any additional considerations or feedback. Responses generally matched those from previously asked questions. With only 23 survey respondents, the resulting data cannot be viewed as a representation of the entire high-rise development community, however some results did tend to affirm anecdotal concerns heard by staff over recent years.

CONCLUSION

FSAE and FBARS are not functionally equivalent. FBARS is a single purpose system providing breathing air supply within a structure to fill SCBA cylinders. FSAE perform the single function of a vertical lifting/lowering car, however offer broader operational utility, enabling safe and efficient movement of personnel and equipment, including SCBA cylinders. Because FBARS is not available in 87 existing high-rise buildings, Department SOP must continue to require that arriving personnel deliver ample breathing air cylinders to the building to support suppression operations. Additionally, FBARS is dependent on arrival of a BASU to supply the system. With only two BASUs, cross-staffed by Squad personnel, arrival can be delayed, thus also requiring that ample breathing air cylinders are delivered to the building even where FBARS is installed. While FBARS does relieve the taxing burden of shuttling breathing air cylinders up and down

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stairs, resources are still required to deliver other firefighting equipment aloft. FSAE, when operating, offer safe and efficient means to achieve incident logistical support objectives. The Department can effectively satisfy operational needs for air supply with either FBARS or FSAE installations in buildings of over 120 feet.

The Department recommends to amend Chapter 17.12 of the San José Municipal Code, allowing designated FSAE as an alternative to FBARS for high-rise buildings over seventy-five feet (75') in height.

EVALUATION AND FOLLOW-UP

The acceptance of this recommendation will require City Council approval to amend Chapter 17.12 of the San José Municipal Code, allowing designated FSAE as an alternative to FBARS for high-rise buildings over seventy-five feet (75') in height and will be included on the September 8, 2020 City Council Agenda.

PUBLIC OUTREACH

The Department conducted a survey inviting 150 developers to respond to 21 questions focused on Department Fire Prevention services, FSAE and FBARS. The Department also conferred with San Jose Fire Fighters, IAFF Local 230 to hear concerns related to high-rise operations.

COORDINATION

This memorandum has been coordinated with the City Attorney's Office, Office of Economic Development and Planning, Building and Code Enforcement.

/s/

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For questions, please contact Hector Estrada, Deputy Fire Chief/Fire Marshal, at (408) 535-7794.