



BVH
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LIFE SAFETY CODE SYSTEMS COMPLIANCE

**25 Sigourney Street
Hartford, Connecticut**

August 20, 2013

Project No. BI-2B-365
BVH Project No. 21-12-153

BVH INTEGRATED SERVICES, P.C.

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BACKGROUND AND PROJECT GOALS

BVH Integrated Services, P.C. has been commissioned by the Connecticut Department of Construction Services to provide an engineering study for the building at 25 Sigourney Street in Hartford, Connecticut. The building was originally constructed in 1987, and it presently serves as office space for various departments of the State of Connecticut.

The project goals, as outlined by the Department of Construction Services, are as follows:

1. To determine whether deactivation of the high-rise smoke control system is permitted in order to simplify system operation. Presently upon notification from the fire alarm system, the building is being fully evacuated.

CODE SUMMARY

1. There are four related life-safety air-control systems in the building:
 - a. A high-rise smoke control system
 - b. A stairwell pressurization system
 - c. A freight elevator lobby pressurization system
 - d. An atrium smoke exhaust system
2. A fire safety code modification from the original construction project permitted staged evacuation of the building if the following terms were met:
 - a. The building is equipped with automatic sprinkler protection
 - b. The building is equipped with standpipes
 - c. The building is equipped with a manual fire alarm system, sprinkler flow activation, heat detection, and smoke detection
 - d. The building is equipped with a stairwell pressurization system
 - e. The building is equipped with smoke control and pressurization on each floor
3. The original fire safety code modification allowing staged evacuation is still considered to be in effect if the systems are restored to their original operating condition. This would likely include modifications and improvements to the stairwell pressurization system, the high-rise smoke control system, and portions of the existing fire alarm system.
4. With approval of the authorities, the automatic high-rise smoke control system may be converted into a manual exhaust system, thus simplifying its operation and improving overall system performance.
5. With approval of the authorities, elimination of the freight elevator lobby pressurization system may be considered.

6. When operating simultaneously, the operation of different air-control systems are likely to influence the efficacy of others. This suggests that modifications to the make-up air for the atrium smoke control system are warranted.

BVH RECOMMENDATION

Eliminate automatic operation of the high-rise smoke control system to a manual smoke control system operational by the Fire Department. This would simplify the operation of the high-rise smoke control system. Eliminate the area of refuge associated with the freight elevator, since area of refuge is not required. The area of refuge associated with the stair tower will remain.

REQUIRED IMPROVEMENTS

Energy Management System

The energy management system at 25 Sigourney provides day-to-day control of the HVAC systems. During an alarm condition, the normal operation of the HVAC system can interfere with the effectiveness of life-safety systems by disrupting pressure relationships, etc. The energy management system must therefore be re-programmed to allow the life safety systems to operate properly.

Atrium Smoke Exhaust System

It is likely that the operation of the atrium smoke control system will influence the proper operation of the stairwell pressurization system. After review, BVH recommends that this influence be eliminated by automatically interlocking the atrium doors to the outside such that they are opened during system operation. This is a commonly-utilized approach for providing make-up air for atrium smoke exhaust systems.

Freight Elevator Pressurization

The freight elevator pressurization system is not required by code, and we are recommending its removal to simplify system operation.

Fire Alarm System

Various modifications to the building's fire alarm system must be made. These include the following:

- Replace most of the building's heat detectors with smoke detectors.
- Correct audibility issues.
- Repair existing pneumatic dampers and other devices associated with the smoke control system.

- Resolve issues with interlocking of security systems with fire alarm system and associated egress requirements.
- Program the smoke dampers to close on any alarm, opening only under manual control of the Fire Department to evacuate smoke after an incident.

OPINION OF PROBABLE COSTS

Our preliminary opinion of probable cost is as follows:

ITEM	COST
BMS rework to not allow system to interfere with fire alarm	\$ 30,000
Atrium smoke exhaust system make-up air	\$ 60,000
Deactivate freight elevator lobby pressurization system	\$ 10,000
Replace existing heat detectors with smoke detectors (assumes 30 devices)	\$ 10,000
Revise fire alarm sequence of operation for air handling units	\$ 15,000
Correct audibility issues with notification devices (assumes 20 new devices)	\$ 10,000
Repair existing pneumatic dampers in air handling systems	\$100,000
Coordinate locations of duct smoke detectors on outside air and exhaust systems (assumes relocating 15)	\$ 15,000
Resolve fire safety code issue with locked doors that release upon fire alarm, but must remain latched	\$ 10,000
Provide fire damper in fire pump room duct	\$ 2,000
Provide fire dampers in generator room ducts	\$ 3,500
Return stair pressurization system to original condition	\$ 35,000
Program all smoke dampers to close on any alarm condition and only open with manual control	\$ 15,000
Program 19th and 20th floors to operate as a single floor for smoke control purposes	\$ 10,000
SUBTOTAL	\$325,500
Design Contingency (10%)	\$ 30,000
Construction Contingency (10%)	\$ 30,000
TOTAL	\$385,500

Notes:

1. Fees and other soft costs are not included
2. Hazardous materials abatement is not included



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LIFE SAFETY CODE SYSTEMS COMPLIANCE

**25 Sigourney Street
Hartford, Connecticut**

January 2, 2013

Project No. BI-2B-365
BVH Project No. 21-12-153

BVH INTEGRATED SERVICES, P.C.

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- 2** **Smoke Control and Fire Alarm Notification Sequence Study by
Philip R. Sherman, P.E.**
- 3** **Drawings**

BACKGROUND AND PROJECT GOALS

BVH Integrated Services, P.C. has been commissioned by the Connecticut Department of Construction Services to provide an engineering study for the building at 25 Sigourney Street in Hartford, Connecticut. The building was originally constructed in 1987, and it presently serves as office space for various departments of the State of Connecticut.

The project goals, as outlined by the Department of Construction Services, are as follows:

1. To determine whether the building can be evacuated in stages rather than being fully evacuated, and;
2. To determine whether deactivation of the high-rise smoke control system is permitted in order to simplify system operation. To this end, BVH has commissioned *Philip R. Sherman, P.E., Fire Protection Engineering and Building Code Consulting*, to perform a code analysis of the building. Mr. Sherman's code report is attached. Presently upon notification from the fire alarm system, the building is being fully evacuated, which is disruptive to areas of the building which are not involved.

CODE SUMMARY

Mr. Sherman's report draws the following conclusions:

1. There are four related life-safety air-control systems in the building:
 - a. A high-rise smoke control system
 - b. A stairwell pressurization system
 - c. A freight elevator lobby pressurization system
 - d. An atrium smoke exhaust system
2. A Fire Safety Code modification from the original construction project permitted staged evacuation of the building if the following terms were met:
 - a. The building is equipped with automatic sprinkler protection.
 - b. The building is equipped with standpipes.
 - c. The building is equipped with a manual fire alarm system, sprinkler flow activation, heat detection, and smoke detection.
 - d. The building is equipped with a stairwell pressurization system.
 - e. The building is equipped with smoke control and pressurization on each floor.
3. The original Fire Safety Code modification allowing staged evacuation is still considered to be in effect if the systems are restored to their original operating condition. This would likely include modifications and improvements to the stairwell pressurization

system, the high-rise smoke control system, and portions of the existing fire alarm system.

4. With approval of the authorities, the automatic high-rise smoke control system may be converted into a manual exhaust system, thus simplifying its operation and improving overall system performance.
5. With approval of the authorities, elimination of the freight elevator lobby pressurization system may be considered.
6. When operating simultaneously, the operation of different air-control systems are likely to influence the efficacy of others. This suggests that modifications to the make-up air for the atrium smoke control system are warranted.

OPTIONS AND BVH RECOMMENDATION

Mr. Sherman's code report offers the following three options for modifications and/or repairs to the systems at 25 Sigourney Street:

Option #1: Return the building fire protection systems to the original condition in order to allow staged evacuation. As Mr. Sherman's report describes, even if the systems were restored to their original operating condition, they would unlikely be able to properly operate in a code-compliant manner.

↓ Option #2: Eliminate automatic operation of the high-rise smoke control system without extensive additional work. This option would simplify the operation of the high-rise smoke control system but would not allow staged evacuation and would therefore not meet one of the project's original objectives.

Option #3: Eliminate automatic operation of the high-rise smoke control system and also upgrade the existing fire alarm system. This option meets both of the key objectives of the project:

- 1) Eliminate automatic operation of the high-rise smoke control system to simplify its operation, and;
- 2) Allow staged evacuation of the building.

In order to meet the stated objective of the project, BVH Integrated Services is recommending that Option #3 be implemented.

• Stairways will have to be areas of refuge.

REQUIRED IMPROVEMENTS

Implementation of Option #3 requires that the following improvements and repairs be performed:

Energy Management System

The energy management system at 25 Sigourney provides day-to-day control of the HVAC systems. During an alarm condition, the normal operation of the HVAC system can interfere with the effectiveness of life-safety systems by disrupting pressure relationships, etc. The energy management system must therefore be re-programmed to allow the life safety systems to operate properly.

Atrium Smoke Exhaust System

As described in Mr. Sherman's report, it is likely that the operation of the atrium smoke control system will influence the proper operation of the stairwell pressurization system. After review, BVH recommends that this influence be eliminated by automatically interlocking the atrium doors to the outside such that they are opened during system operation. This is a commonly-utilized approach for providing make-up air for atrium smoke exhaust systems.

Freight Elevator Pressurization

As described in Mr. Sherman's report, the freight elevator pressurization system is not required by code, and we are recommending its removal to simplify system operation.

Fire Alarm System

In order to allow staged evacuation, various modifications to the building's fire alarm system must be made. These include the following:

- Replace most of the building's heat detectors with smoke detectors.
- Correct audibility issues.
- Repair existing dampers and other devices.
- Resolve issues with interlocking of security systems with fire alarm system and associated egress requirements.
- Program the fire alarm system to provide a warning message to portions of the building not being evacuated.
- Program the smoke dampers to close on any alarm, opening only under manual control of the Fire Department to evacuate smoke after an incident.

- Modify fire alarm control of the atrium smoke control system.
- Rewire the fire alarm notification circuits with survivable cabling to comply with NFPA 72.

Miscellaneous Improvements

Mr. Sherman’s report included resolving the fire safety code issue with the glass enclosed stair #3 (garage), which he noted as a code violation; however, since we are not reworking any systems in this area and it appears to be outside of the project scope, we have not included any budget estimate for this work.

OPINION OF PROBABLE COSTS

Our preliminary opinion of probable cost is as follows:

ITEM	COST
BMS rework to not allow system to interfere with fire alarm	\$ 30,000
Atrium smoke exhaust system make-up air	\$ 60,000
Deactivate freight elevator lobby pressurization system	\$ 10,000
Replace existing heat detectors with smoke detectors (assumes 30 devices)	\$ 10,000
Revise fire alarm sequence of operation for air handling units	\$ 15,000
Correct audibility issues with notification devices (assumes 20 new devices)	\$ 10,000
Repair existing pneumatic dampers in air handling systems	\$100,000
Coordinate locations of duct smoke detectors on outside air and exhaust systems (assumes relocating 15)	\$ 15,000
Resolve fire safety code issue with locked doors that release upon fire alarm, but must remain latched	\$ 10,000
Provide fire damper in fire pump room duct	\$ 2,000
Provide fire dampers in generator room ducts	\$ 3,500
Modify the fire alarm system to provide messaging to non-alarmed portions of the building	\$ 12,500
Return stair pressurization system to original condition	\$ 35,000
Program all smoke dampers to close on any alarm condition and only open with manual control	\$ 15,000
Program 19th and 20th floors to operate as a single floor for smoke control purposes	\$ 10,000
Rewire fire alarm notification circuits to comply with NFPA 72 requirements for survivability and partial evacuation	\$115,000

ITEM	COST
Testing of fire alarm system (Contractor)	\$ 25,000
Testing of fire alarm system (Fire Department)	\$ 25,000
<i>SUBTOTAL</i>	<i>\$503,000</i>
Design Contingency (10%)	\$ 50,300
Construction Contingency (10%)	\$ 50,300
<i>TOTAL</i>	<i>\$603,600</i>

Notes:

1. Fees and other soft costs are not included
2. Hazardous materials abatement is not included

PHILIP R. SHERMAN, P.E.

FIRE PROTECTION ENGINEERING AND BUILDING CODE CONSULTING

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Date: December 6, 2012
Proj: 1599.01

BVH Integrated Services, Inc.
50 Griffin Road South
Bloomfield, CT 06002

Attention: Mr. Gregory Van Deusen, P.E.

Re: 25 Sigourney Street
Hartford, Connecticut
Smoke Control and Fire Alarm Notification Sequence Study
75% Report
Revision One

Dear Mr. Van Deusen:

25 Sigourney Street, Hartford, CT, is an existing office and parking structure, occupied by various State of Connecticut departments. The building was originally constructed in 1987 as a commercial structure, and was occupied, with minor renovations, by the state in the early 1990's.

Goal of Study

The goal of this study is twofold:

- First, to determine if the current procedure for total emergency evacuation may be returned to the original, partial evacuation, procedure.
- Second, to determine if deactivation of any of the smoke control systems is permitted.

This study is limited to the code implications, and the functionality, of the building only as it relates to the above two goals. A complete fire safety or evacuation study of this building is

outside the scope of this work, and no conclusions are drawn as to the overall level of safety. No testing of fire protective systems has been witnessed by this writer.

Executive Summary

This building was originally designed for evacuation of the fire floor, plus one floor below and two floors above the fire floor. In 2010, procedures and alarm signals were changed to provide total evacuation on any alarm.

A 2012 test of portions of some of the smoke control systems found problems with stair pressurization, high rise smoke control and freight elevator lobby pressurization systems. The atrium smoke control system was not tested.

A review of the code implications for the evacuation procedure and the various smoke control systems finds that the partial evacuation was permitted by a code modification at the time of construction. Stair pressurization and atrium smoke control systems are required by the current codes and must be repaired and maintained. The high rise smoke control and freight elevator pressurization systems are not required and may be removed, except that the high rise system was used as justification for the code modification. The future code will likely require the exhaust portion of the high rise system, but in a manual mode.

Three alternatives are presented. The first alternative returns the systems to their original condition, and utilizes partial evacuation. It is probable that this approach will difficult to achieve due to problems balancing the various systems. The second alternative , places the high rise system in a manual mode, and utilizes total evacuation. The third alternative places the high rise system in a manual mode, utilizes partial evacuation with a new code modification, and upgrades the fire alarm notification wiring as required by current codes for partial evacuation.

Applicable Documents

The following documents have been utilized in this study:

- 2003 International Building Code portion of the 2005 Connecticut State Building Code (2005 CSBC), with 2009 and 2011 amendments
- 2005 Connecticut State Fire Safety Code (CSFSC), with 2009 and 2012 amendments
- 2010 Connecticut State Fire Prevention Code (CSFPC)
- State of Connecticut Basic Building Code/1978 (1981 CSBC), effective September 1, 1981, in effect at the time of construction.

- 1994 Connecticut State Building Code, appears to have been effective at the time of the area refuge upgrade.
- 1981 Connecticut Fire Safety Code, in effect at the time of construction
- 2012 International Building Code (2012 IBC), proposed for adoption in Connecticut in the near future
- Building Condition Survey, by Hoffman Architects, September 30, 1992
- 2007 fire alarm replacement project Simplex riser diagrams
- Various drawings from the original construction. Not all drawings were available.
- Fire Safety Code modification M87-218
- Advanced Testing & Balancing Co., Inc. test report on high rise and stair pressurization systems, report dated February 20, 2012
- Konover Commercial Corporation internal report on the same test, dated February 10, 2012.
- Various other fire protective system test reports

Summary of Existing Conditions

The building is primarily a Group B structure. Garages are Group S-2, the cafeteria is Group A-2, and some fifth floor training rooms may be Group A-3. The fourth floor convenience store is an accessory occupancy, as are upper floor training rooms.

The P1 level is a vacant enclosed parking garage and is probably classified by the code as a basement. The P2 and P3 levels are vacant parking levels and appear to be classified as open parking garages and as stories above grade. Levels P4 and P6 consist of a mix of open parking and business use, with Level P4 also the office lobby. A portion of the P4 parking level is actively used for parking. The P5 parking level is between office floors and is vacant, and level P6 is the so-called mezzanine floor, actually the sixth floor level. Office floors include 4, 6-12, and 14-20. There is no fifth level office floor, or 13th floor. This totals 19 floor levels, one of which is probably a basement. Additional mechanical penthouses are located on the roof. The building is considered a high rise building.

The footprint area is about 66,000 sf, and office floors are about 32,500 sf per floor. Approximately 1400 people occupy the building.

The construction type of the building is not known. The 1981 code required BOCA Type 2A construction (IBC Type I-B but with 1.5 hour floors) but given the concrete structure, it is possible that full two hour floors were still provided.¹ The building is open to a 30 foot clear space on all sides.

Stair 9 and 10, elevator and mechanical shafts appear to be rated, but the details are not known. Stair 3, serving the vacant garage levels, is marked as an exit, but is enclosed with tempered glass. A three story atrium connects the fourth to the sixth floors. There is an open stair between the 19th and 20th floor. Corridors are not rated and incidental use areas were not reviewed.

Fire protection systems include the following

- A Simplex 4100U fire alarm system, consisting of a fire command center off of the level P2 loading dock, manual pull stations, waterflow, tamper and fire pump alarms, limited smoke and heat detection, duct smoke detection, voice alarm and strobe lights. A master box is provided, and trouble/supervisory signals report to the 24/7 security desk in the building.

A system of firefighter telephone jacks is provided. Emergency telephones for occupant use are provided in stairs 9 and 10 about every five floors, in the stair 9 areas of refuge and in the freight elevator lobby areas of refuge.

The fire alarm system controls the various smoke control systems as well as elevator recall. A firefighter smoke control panel in the fire command center has controls for fans including stair pressurization, high rise control, atrium smoke control, freight elevator lobby pressurization, toilet exhaust, outside air supply and air handlers on each floor. Stair relief dampers are also controllable.

- The building is reported to be fully sprinklered, except for the portion of the vacant enclosed and open parking garage that is not under the office part of the building, and a transformer vault.
- An automatic wet standpipe system serves the three exit stairs. Dry standpipes serve the garage.
- Stair pressurization systems are provided for Stair 3, connecting P1 - P4, stair 9 connecting P4 - 19 and stair 10 connecting P5 - 20.
- An atrium smoke control system is provided.

¹ Drawing S-5, generally 9" slabs in tower, drawing S-2, generally 6" post tensioned slabs in garage. A detailed review of drawings was not performed.

- A high rise smoke control system is provided on office floors.
- The freight elevator lobby areas of refuge are provided with a pressurization system
- All fans are reported to be on generator power, but the generator capacity is provided only as required for the smoke control design. Elevators are on generator power, and are switchable to one elevator at a time.

Code Analysis

Partial Evacuation

- Fire Safety Code modification M87-218 approved the use of partial evacuation, for the fire floor, the floor below the fire floor, and two floors above the fire floor. No building code modification has been provided to date.
- **1975 NFPA 72A applied at the time of construction.** This code was not reviewed, but survivability requirements entered the code in the 1990s, so it is assumed that the 1975 code did not have specific provisions for notification circuit survivability.
- **The 2007 fire alarm replacement project reused original existing wiring, and did not upgrade the wiring methods so as to be in compliance with 2002 NFPA 72 for partial evacuation and notification circuit survivability.**
- Due to concerns from occupants on floors not alerted by the voice alarm, in 2010 the evacuation procedure and alarm signals were changed to result in full building evacuation.
- At the present time, the desire is to return to partial evacuation.
- Even with the procedure having been changed to use full evacuation, the code modification is still in effect and partial evacuation is permitted under the terms of the code modification. These terms included:
 - Automatic sprinkler system
 - i. The code modification does not refer to “complete” or “full” automatic sprinkler protection. Provided the removal of the sprinklers from the garage was done with the proper permits and approvals, this requirement appears to still be satisfied
 - Standpipes. This requirement is satisfied.

- Manual fire alarm system, sprinkler flow activation, heat and smoke detection. This requirement is satisfied.
 - Smoke control and pressurization on each floor. See discussion below, system is present, but does not operate per code.
 - Stair pressurization. See discussion below, system is present, but does not operate per code.
- Legally, partial evacuation is permitted under the terms of the 1987 code modification, but only when the systems that were offered in the code modification area operable.

High Rise Smoke Control System

- The existing high rise smoke control system was apparently installed as required by 1981 CSBC 431.7.2. This requirement applied to high rise buildings and stated “*Smoke control: Natural or mechanical ventilation for the removal of products of combustion shall be provided in every story and shall consist of one (1) of the following:*
 1. ...
 - .2. *When a complete and approved automatic fire suppression system is installed, the mechanical air handling equipment may be designed to accomplish smoke removal. Under fire conditions, the return and exhaust air shall be moved directly to the outside without recirculation to other sections of the building. The air handling system shall provide a minimum of one (1) exhaust air change each ten (10) minutes of the area involved.*
 3. ...”
- Code modification M87-218 offered “Smoke control and pressurization on each floor” as an equivalency, in order to justify partial evacuation. While the smoke control system was required by the code as indicated above, the addition of pressurization of two floors above the fire floor, and one floor below the fire floor was in addition to the code, although not explicitly stated in the code modification application.
- 2005 CSBC does not require a smoke control system for the floors.
- The 2012 IBC returns to the 1981 CSBC method, but for a different purpose. Section 403.4.6 requires an exhaust system, but at four air changes per hour rather than six, and is clear that the intent of the system is for post fire smoke removal, not for life safety.
- Legally, this system is required only by the terms of the original code modification.

Stair Pressurization System

- 1981 CSBC 618.2 required one stair to be a smokeproof enclosure. Section 618.2.1 and 618.9.3 permitted the smokeproof enclosure to be eliminated, provided all interior stairways were pressurized to 0.15 inches water with a minimum of 2500 cfm discharge at the top of the shaft with supply air introduced at the level of exit discharge.
- 2005 CSBC 1019.1.8 and 909.20 require stairs 9 & 10 to be pressurized to 0.15 - 0.35 inches water relative to the building, with all doors closed under maximum anticipated conditions of stack effect and wind effect.
- 2012 IBC 403.5.4, 909.20, and 1022.10 require stairs 9 & 10 to be pressurized to 0.10 - 0.35 inches water, relative to the building, with all doors closed under maximum anticipated conditions of stack effect and wind effect.
- Legally, this system is still required for stairs 9 and 10.

Atrium Smoke Control

- 1981 CSBC 520 had provisions for open wells, but did not include provisions for atria. 1981 CSFSC 6-1.1.2 had provisions for three story floor openings, but no provisions for atria.
- 1981 CSBC was based on the 1978 edition of the BOCA Basic Building Code. At the time of construction, however, the 1981, 1984 and 1987 BOCA codes had been published and each of these codes had provisions for atrium smoke control, including varying requirements for makeup air.
- As the atrium itself was not permitted by 1981 CSBC, it is possible that the provisions of a later national model code were provided. No code modification has been provided indicating approval of the atrium or atrium smoke control system.
- 2005 CSBC 404.4, with 2009 amendments, requires a smoke control system for the three story atrium.
- 2012 IBC 404.5 requires a smoke control system for the three story atrium.
- Legally, this system is still required.

Freight Elevator Lobby Pressurization System

- This system appears to have been installed as part of the area of refuge upgrade. Per 1994 CSBC 807.8.6, the elevator lobby and shaft were to comply with requirements for smokeproof enclosures in 819.0. This section was written for stairs, but was applied to elevators by the 807.8.6 reference. Section 819.7 permitted (stair) pressurization in lieu of vestibules and it may be this exception was used at the freight elevator.
- 2005 CSBC does not require the area of refuge at an accessible elevator in a fully sprinklered building.
- 2012 IBC does not require the area of refuge at an accessible elevator in a fully sprinklered building.

Code Basis for Maintenance of Required Fire Protective Systems and Maintenance or Removal of Non-required Fire Protective Systems

- CSBC 3401.2 requires existing systems to be maintained, and states that *“The requirements of this chapter shall not provide the basis for removal of abrogation of fire protection and safety systems and devices in existing structures.”*
 - The 2003 IBC Commentary states: *“The removal of a previously required existing safety system is not permitted, even if the structure would meet the minimum requirements of this chapter without that system. For example, an existing sprinkler system in part of a building must remain functional, even if the system was not required ...”*

This statement conflicts with the 2003 International Fire Code section 901.6. This code is not adopted in Connecticut, but is coordinated with the IBC on which the Connecticut code is based. IFC 901.6 states; *“Non-required fire protection systems and equipment shall be inspected, tested and maintained, or removed.”*
 - The 2012 IBC uses precisely the same language in section 3401.2 of the code, however, the 2012 commentary has been corrected to clarify that systems that are required by current code need to be maintained, but that systems no longer required by the code may be removed. The commentary further clarifies that (removal) of an existing system does not require a complete re-review of an entire building, but only those elements where removal of the system would move the building out of compliance with the current code.
 - CSBC 3403.1 prohibits any alteration that causes the existing building to be in violation of the code. CSBC 105.1 requires permits for the removal or other alteration of a fire safety device.

- CSFSC Part IV, section 4.6.13.2 requires “Existing life safety features obvious to the public, if not required by this code, shall either be maintained or removed.”
- CSFPC 10.4.3 requires “Existing life safety features obvious to the public, if not required by this code, the CSFSC or the (C)SBC shall be either maintained or removed.”
- Provided the authorities agree with the commentary clarification above, non required systems may be deactivated with a permit.

Technical Considerations

Fire Alarm System

- The fire alarm system provides voice and visual notification, and the logic and control for the various smoke systems. The main fire alarm panel and the firefighters smoke control panel, are located in the fire command center, with remote transponders located on about every third floor.
- No written sequence of operation or operation matrix has been found.
- The 2007 alarm upgrade reportedly reused existing wiring and, as full evacuation was used at the time, wiring was not updated to current code provisions for partial evacuation.
- The alarm system is currently programmed to alert the entire building upon alarm. The system is capable of providing zoned evacuation, and, with some modifications, also send an alternate message to non-fire floors.
- Audibility problems have been reported in the freight elevator lobbies

High Rise Smoke Control

- Upon alarm, the air handlers on the fire floor shut off, supply air damper at the fire floor closes, and the damper to the smoke control system opens. On the floor below the alarm, and two floors above, the exhaust dampers remain closed, and the supply air dampers are opened, air handlers operate. On other floors, all dampers close, and air handlers shut down.
- Exhaust fan SEF-1 @28,000 cfm, serves floors 4 - 19. SEF-2@10,500 cfm serves the north portion of floor 5, and SEF-3@14,500 cfm serves the south part of floor 5. SEF-5@6,000 cfm serves floor 20.

- SF-1@49,000 cfm and SF-2@49,000 cfm provide outside air to floors 4-19. AHU 16@1200 cfm serves floor 20. *Other air handlers may serve various areas. The outdoor air system is designed to supply day to day air, and to redirect all available supply air to the three floors near the fire floor, but is reported to not have capacity to pressurize all floors at once.
- Smoke/fire dampers at each air handler room are original and utilize pneumatic controls. These are controlled individually by a fire alarm module, but some or all dampers also appear to be controlled by the energy management system.
- It appears that no specific floor to floor differential pressure was intended by the design, and pressure readings between floors have not been reported. See stair pressurization section below for further pressure issues.
- No testing of this system with the atrium smoke control system also in operation has been reported. It is unknown whether this results in conflicts in control logic, or in problems with pressure differences or air flows.
- No complete, floor by floor test of this system has been reported. The February 2012 test was limited to activating the alarm on the 12th floor.
- It is unknown how the 19th and 20th floor, which are connected by an open stair, are intended to operate.
- Duct smoke detectors are located at the outside air fans at the penthouse.
- At the time of the February 2012 test, this system did not function as intended, due to the energy management system overriding the fire alarm signals.

Stair Pressurization

- SPF-1@10,000 cfm supplies Stair 9 through a duct at five locations. PV-1 modulates to provide the required 2500 cfm exhaust and the set 0.2 inches water. SP-2 and PV-2 are a duplicate system for Stair 10.
- PV-1 and PV-2 were found not to modulate during the February 2012 test. Parts are not easily available.
- During the February 2012 test, some floors were positive relative to the stair, some doors did not latch, and some egress door forces were excessive. However, the pressurization dampers were bypassed so as to open fully, and without these dampers modulating, the readings are invalid.

- The Advanced report recommends using the energy management system to control the fans on the floors. This approach should be used with care, as the energy management system would then need to comply with all applicable requirements for smoke control systems.
- The system is set for 0.2 inches water. 0.15 inches water was required at the time of construction, 2012 IBC would allow this to be reduced to 0.1 inches water.
- SPF-3@3,000 cfm serves stair 3 at the bottom, relieving at the top into the garage. This system was not tested during the February 2012 test.

Atrium

- SEF-4@10,300 cfm exhausts air from the atrium.
- Makeup air is provided via AHU 2S, however the control sequence for this unit is not clear.
- How this system is currently activated has not been determined.

Freight Elevator Pressurization

- The size of the freight elevator lobby pressurization fan is unknown.
- Testing indicates significant leakage to the elevator shaft, which is expected as dampers at the top of the shaft open to the exterior upon alarm. Lobby doors to the lobby do not close properly when the system is in operation.

Operational Conflicts between Systems

- Currently, in the event of a fire, three, and sometimes four, smoke systems operate at one time. Stair and freight elevator lobby pressurization systems operate, the fire floor operates negative, and three adjacent floors operate positive. If the fire is in the atrium, this system also operates. At the least, the systems are not currently balanced properly, and it is likely that at least the atrium and freight elevator lobbies cannot be properly balanced against the stair and floor systems, given the present arrangement.

Other Issues

A complete code study of the building is outside the scope of this study, but the following issues were noticed during the site visit.

- Stair 3 is enclosed by tempered glass. This has never been permitted by CT codes for egress stairs and is a violation of CSFSC Part IV 7.1.3.2.1.
- Stair doors are normally locked and unlock upon signal from the fire alarm system. Latches release during this unlocking operation. This is a violation of CSFSC 7.2.1.5.2 and 7.1.3.2.1(4)
- Egress from many elevator lobbies is provided only by card key access.
- A transfer grill penetrates the fire pump room and a fire damper is not provided.
- Ductwork enters the generator room and a fire damper is not provided.

Conclusions

Regardless of other actions taken, systems required by the current codes must be maintained in an operable condition. Some systems are required due to the 1987 code modification. Consideration of deactivating non-required systems may be in order.

Conclusions are presented in terms of three alternatives. First, a process to return the building fire protection systems to the original condition and permit the desired partial evacuation. Second, to utilize a total evacuation procedure, in order to eliminate automatic control of the high rise smoke control system. Third, to upgrade the fire alarm system to permit partial evacuation while still eliminating automatic control of the high rise smoke control system. Conclusions start with common improvements, that apply to all of the alternatives.

Improvements Common to all Alternatives

- Reach agreement with the authorities as to the intent of CSBC 3401.2.
- Program the energy management system so as to not control the various smoke, supply and floor return fans during an alarm.
- Confirm control sequence for atrium smoke control activation and make up air.
- Provide make up air by means of powered open exterior doors, rather than through air handler. This is thought to be required in order to help isolate the atrium system from the stair pressurization system.
- Freight elevator lobby pressurization
 - Obtain approval to remove/deactivate freight elevator pressurization, not required by current code.

OR

- If the freight elevator lobby pressurization system is to remain, provide closed vents at freight elevator per current building and energy codes, and size system to pressurize both elevator and lobbies and adjust lobby doors to open and close properly.
- Other than as required for elevator recall, remove all heat detectors and, where appropriate, replace with smoke detectors.
- Confirm whether other air handlers are present that are, or should be, connected to the high rise or atrium smoke control systems.
- Generate detailed, written sequence of operation and operating matrix for fire alarm and all smoke systems to remain.
- Correct audibility issues with freight elevator lobbies, and if necessary, survey remainder of the building for audibility and correct as necessary.
- Repair all existing dampers and other devices, and if obsolete, replace with currently available equipment.
- Review locations of all duct smoke detectors on outdoor air and exhaust systems and coordinate with requirements for high rise smoke control system.
- Resolve fire safety code issue with glass enclosed stair 3.
- Resolve fire safety code issue with locked egress doors, that only unlock on alarm. Doors must remain latched when unlocked.
- Resolve fire safety code issue with locking of elevator lobbies.
- Provide fire damper in duct in fire pump room
- Provide fire dampers as required for ducts through generator room

Alternative One

- Use partial evacuation under the provisions of the 1987 code modification.
- Modify fire alarm system to provide warning message to portions of the building not being evacuated.

- Return all systems to original operating condition. There may be a need to modulate the air supply to the fire floor, and to adjacent floors, to achieve required pressure differentials to stairs. If necessary, process code modification to reduce required stair pressure to 2012 IBC limit. Do not use energy management system for smoke control purposes unless there is no other way. If it is used, comply with applicable current code requirements for smoke control systems.
- Clarify what activates the atrium smoke control system currently, and assure that only alarms within the atrium activates the atrium system. This includes installing spot or beam smoke detection in the atrium, and possibly re-zoning sprinkler piping.
- Program the high rise smoke control system to activate on floors 4, 5 and 6 only for alarms outside the atrium.
- Program 19th and 20th floors to function as a single floor for high rise smoke control purposes.
- Test stair pressurization, atrium and high rise systems in all combinations of activation.

Alternative Two

- Maintain current total evacuation procedure for building.
- Return stair pressurization system to original operating condition. If necessary, process code modification to reduce required stair pressure to 2012 IBC limit.
- Process code modification to place the high rise system on manual control, for use by fire department after an incident. Program 19th and 20th floors to function as a single floor for high rise smoke control purposes. Comply with 2012 IBC.
- Program all smoke dampers to close on any alarm, opening only on manual control.
- Clarify what activates the atrium smoke control system currently, and assure that only alarms within the atrium activates the atrium system. This includes installing spot or beam smoke detection in the atrium. If the system activates for other alarms on floors 4, 5 or 6, due to existing sprinkler zoning, this is acceptable.
- Program 19th and 20th floors to function as a single floor for high rise smoke control purposes.
- Test stair pressurization and atrium system together.

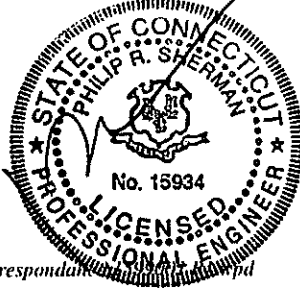
Alternative Three

- Process new code modification to permit partial evacuation procedure for building.
- Modify fire alarm system to provide warning message to portions of the building not being evacuated.
- Return stair pressurization system to original operating condition. If necessary, process code modification to reduce required stair pressure to 2012 IBC limit.
- Process code modification to place the high rise system on manual control, for use by fire department after an incident. Program 19th and 20th floors to function as a single floor for high rise smoke control purposes. Comply with 2012 IBC.
- Program all smoke dampers to close on any alarm, opening only on manual control.
- Clarify what activates the atrium smoke control system currently, and assure that only alarms within the atrium activates the atrium system. This includes installing spot or beam smoke detection in the atrium. If the system activates for other alarms on floors 4, 5 or 6, due to existing sprinkler zoning, this is acceptable.
- Program 19th and 20th floors to function as a single floor for high rise smoke control purposes.
- Test stair pressurization and atrium system together.
- Rewire fire alarm notification circuits to comply with NFPA 72 requirements for survivability and partial evacuation.

The choice between the various alternatives will depend on the available dollars, the priority of the desire for partial evacuation, and the ability to balance the original systems.

Yours truly:

Philip R. Sherman, P.E.



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