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Memorandum

Date:	August 3, 2022	Project#:	225426
To:	Nault Architects		
From:	Jeremy Souza, P.E. – Code Red Consultants		
Re:	Arnold C. Weller, Jr. Academic Center 61 Sever St, Worcester, MA		
Cc:	David A. Carrillo – Code Red Consultants Dan Picciano, P.E., CFPS – Code Red Consultants		

Code Red Consultants (CRC) has been retained by Nault Architects to perform an evaluation on the existing fire alarm and fire protection systems located within the existing building located at 61 Sever Street in Worcester, MA. The intent of this evaluation is to outline the existing conditions of the fire alarm and fire sprinkler systems as well as their capabilities to support the proposed new occupants and their desired usage. This evaluation does not include any NFPA 25 or NFPA 72 functionality testing and/or inspections. It is assumed all existing systems are regularly inspected, tested, and maintained in accordance with the requirements of the Massachusetts Comprehensive Fire Safety Code (527 CMR 1.00), referencing NFPA 25 and NFPA 72.

This evaluation was derived from the following sources of information:

- A visual, non-destructive site survey by CRC on July 12th, 2022
- Record Drawings:
  - Sheets FP-1, FP-2, & FP-3 from "Becker Jr. College Academic Center Renovations 1987" Phase 1 drawings dated Oct. 19, 1987
  - Sheets FP-1, FP-2, & FP-3 from "Becker Jr. College Academic Center Renovations Phase II" as-built drawings dated 05/07/90.
  - Sheet E-6 from "Becker Jr. College Academic Center Renovations 1987" Phase 1 drawings dated Oct. 19, 1987
  - Sheet E-6 from "Becker Jr. College Academic Center Renovations Phase II" drawings dated Apr. 3, 1989.
- Drawings "Renovations to 61 Sever St Worcester School Dept. Adult Education Program" by Nault Architects, Inc. dated June 2022.
- Annual Sprinkler Inspection Report by Impact Fire Services, LLC dated 05/11/2022
- NFPA 72 "Fire Alarm and Emergency Communication System Inspection and Testing Form" by D.A.B. Security Systems, Inc. dated May 18, 2022.

Applicable Codes

This memo is based on the following statutes, codes, and standards:

- 780 CMR, Massachusetts State Building Code, Ninth Edition, which is an amended version of the 2015 *International Building Code*, and including Chapter 34 – an amended version of the 2015 *International Existing Building Code* otherwise known as the *Existing Building Code of Massachusetts* (referred to herein as "MEBC")

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- 527 CMR 1.00, Massachusetts Comprehensive Fire Safety Code, 2017 edition; which is an amended version of NFPA 1, *Fire Code*, 2015 edition and includes selected elements from NFPA 1, 2018 edition added in October 2019.
- NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2013 Edition
- NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2013 Edition
- NFPA 20, *Standard for the Installation of Stationary Fire Pumps for Fire Protection*, 2013 Edition
- NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2017 Edition
- NFPA 72, *National Fire Alarm and Signaling Code*, 2013 Edition

Existing Building Description

61 Sever Street is an existing two-story building, with one sub-grade basement level and an unoccupied attic. The construction type of the building most closely resembles Type VB, nonprotected combustible, as the attic spaces and floors are comprised of dimensional wood framing. No destructive testing was conducted to determine wall construction materials. The building has a footprint of approximately 16,100 sqft and total area of approximately 46,800 sqft. Currently, this building is occupied and being utilized as an academic building primarily containing offices, classrooms, and computer labs. Additionally, the building contains a library, lecture hall and dining area as well as computer/electronic storage rooms.

The building is a mixed-use building which comprises of Use Group A-2, Group A-3, Group B, and Group S.

It is our understanding that the library portion of the building was originally constructed in the mid 1960s, with the remainder of the building constructed as an addition. From a code perspective, the two sections are treated as a single building.

Fire Alarm System Evaluation

Existing Fire Alarm System

61 Sever Street is equipped with a conventional zoned fire alarm system which is controlled and monitored by a Simplex 4002 Fire Alarm Control Unit (FACU). The existing FACU is located on the Second Floor within the reception office. A remote annunciator panel is provided on the exterior of the building outside of the main entrance. Mounted above the FACU is a Notification Appliance Circuit (NAC) extender panel and a Starlink communicator, which transmits all signals to a Central Station. The existing fire alarm system is believed to have been installed during the 1987 renovation project.

FIGURE 1: MAIN FIRE ALARM CONTROL UNIT (FACU)

FIGURE 2: REMOTE ANNUNCIATOR PANEL

The building appears to be provided with conventional smoke detection throughout, including elevator lobbies. Full smoke detector coverage is indicative of the fire alarm design philosophy of the late 1980s and early 1990s when the fire alarm system was installed. Conventional heat detectors were observed in storage closets, mechanical spaces, and other locations where the environmental conditions were inappropriate for smoke detectors. Those smoke and heat detectors adjacent to elevators and within the elevator machine room are all believed to initiate Phase 1 fire service recall functionality (automatic recall on smoke detector activation). Elevators do not appear to be provided with Phase 2 fire service recall functionalities (key-operated control by the fire department).

In additional to the Fire Alarm system components, it is believed that the FACU monitors the building's fire protection systems via tamper and flow/pressure switches, as well as the kitchen hood suppression systems. The building is provided with an emergency generator; however, it is unknown if the generator is monitored by the building's FACU.

Proposed Modification to Existing Fire Alarm System

It is CRC's understanding that the 61 Sever St building is intended to undergo renovations that will include reconfiguration of spaces, but will not exceed 50% of the building's area, which would be classified as a Level 2 renovation. The Existing Building Code of Massachusetts (MEBC) requires all buildings undergoing Level 2 renovations to be provided with a fire alarm system throughout the work area.

Fire Alarm Control Unit (FACU)

The existing conventional Simplex 4002 FACU was formally discontinued for new installations by Simplex in 1998, and parts supplies were discontinued in 2017 (See Appendix A.) If this panel fails (via mechanical damage, failed components, power surge, etc.), the panel would need to be replaced on an emergency basis. It is recommended to replace the existing FACU with a new, addressable FACU in accordance with the following:

- The new Fire Alarm System should comply with NFPA 72, 780 CMR, and 527 CMR 1.00 requirements.
- New FACU wiring should minimally be Class B and installed in accordance with NFPA 70 and NFPA 72.
- All conductors should be splice free and continuous from device to device. The use of wire nuts, crimped connectors, or twisting of conductors should not be permitted.
- Secondary power (batteries) must be sized to provide 24 hours of standby and an additional 5 minutes of alarm activation at the end of the standby time.
- New FACU should be located at the same location of the existing FACU or coordinated with the project's architect, owners, and Worcester Fire.
- New FACU should be provided with a means to transmit signals off-premises. A dual path communicator is recommended.
- New FACU should be provided with a remote annunciator with control functions that same as the main FACU, located near the main entrance of the building.

Initiation Devices:
Detection systems, particularly smoke detection systems, require significant maintenance. The required detectors must be properly installed and maintained. Smoke detection should be provided in locations that are required by the applicable codes and standards. As a component of the project, existing smoke detection may be removed in locations where they are not required by code and are not desired by Ownership. New addressable initiation is expected to be needed in these locations:

- Smoke detection in the vicinity of fire alarm control unit(s).
- Smoke detection in elevator lobbies/outside of each hoistway door and machine rooms.
- Smoke detection in supply air ducts over 2,000 CFM, and in return air ducts over 15,000 CFM.
- Addressable monitoring of all sprinkler valves, water flow switches, and suppression systems (including hood suppression).
- Addressable manual pull stations on every occupiable level and within 5 feet of all exits.
- Carbon monoxide detection in rooms where fuel-burning appliances are located and downstream of fuel-burning HVAC equipment.

Notification:
Fire alarm notification for occupants should be provided in accordance with the applicable codes and standards. Notification coverage should be provided throughout the interior and around the building at entrances/exits and other locations commonly used by occupants.

- Provide a minimum of one Notification Appliance Circuit (NAC) per floor. Each NAC should include 25 percent spare capacity.
- Provide Audible Notification Appliances throughout.
    - Test and document audibility and intelligibility in designated Acoustically Distinguishable Spaces. Audibility must meet NFPA 72 standards; intelligibility must meet a minimum of 0.8 CIS.
    - The alert signal portion for carbon monoxide detection must be a 520 Hz, temporal 4 signal.
- Provide Visible Notification Appliances throughout.
    - Clear lens strobes throughout for fire alarm notification.
    - Visible notification must be provided in unoccupied areas greater than 900 ft^2 and offices designed for or may contain more than four persons at any one time.
    - Red fire alarm beacon(s) should be provided on the exterior of the building
- Provide dedicated Notification Appliance Circuit for exterior sprinkler bell.

Fire Protection System Evaluation

Existing Fire Protection System
The existing building is currently provided with two 4-inch dry-pipe system risers which are fed by a 4-inch feed connected to the city water supply.

FIGURE 3: SPRINKLER SYSTEM RISERS

The first dry pipe valve, on the left in Figure 3 above, is a 4-inch valve, which appears to be original to the building. While a manufacturing date was not noted in the casting for the valve body, the valve shows patent dates of 1919 and 1927. The air system pressure for this valve was shown as 47 psi at the time of the inspection, which is substantially higher than generally seen for dry pipe systems (15 to 25 psi is generally the expected range). As original operating and maintenance instructions for the valve are not available, this pressure cannot be verified.

The second dry pipe valve is "stacked" above a wet pipe alarm check valve. The wet pipe valve, a Rockwood Model F, has a casting date of 1960, and is the same manufacturer as the dry pipe valve. The dry pipe valve, a 4-inch Reliable Model D, has a casting date of 1993. Similar to the first dry pipe valve, the air pressure in this system was noted as 50 psi

Based on this "stacked' valve arrangement, as well as the as-built FP drawings, it is believed that the building was originally provided with a wet-pipe system, which was converted to a dry-pipe system.

The system design data placards located at both system risers indicates that both systems have been hydraulically calculated to a density/area of 0.115 gpm/sqft over a remote area of 1950 sqft. This density is not typical; the expected densities would be 0.10 gpm/sqft for Light Hazard and 0.15 gpm/sqft for Ordinary Hazard, Group 1. It is not known why this density was chosen.

During CRC's site survey it was observed that sprinklers are provided in most areas of the building, including within concealed combustible spaces such as in the attic and above suspended ceilings. It was observed that the Main IT/Computer room (Room 104) was not provided with sprinkler coverage, it appears that these sprinklers were cut, capped, and removed. It is unknown if the elimination of sprinklers in this room was properly permitted.

During the site survey, it was noted that the wet pipe sprinkler system within the building had been converted to a dry pipe system. From discussions with Nault Architects and with facilities staff on site, it is our understanding that the wet system had been plagued with small leaks and that the corrective action was to convert the system to a dry sprinkler system. Dry sprinkler systems require the ability to remove all trapped water should the system activate[a], while wet pipe systems only require full drainage for maintenance operations (sections of pipe with less than 5 gallons of water do not require drains). Numerous locations throughout the building showed areas where water would be trapped during an activation. Individual pendent-style sprinkler drops and low piping segments without auxiliary drains were noted throughout the building. These locations will retain water after an activation, which will remain in the piping system and contribute to corrosion within the piping. Figure 4 shows a typical return bend which cannot be drained and will trap water.

FIGURE 4: PIPING SEGMENT TRAPPING WATER (TYPICAL)

[a] Dry sprinkler systems have piping that is full of compressed air under normal circumstances. When a sprinkler head opens, the air drains from the piping, which opens the dry pipe valve, admitting water into the piping system. This water must be removed from the piping when the system is returned to service.

It was additionally noted that repairs to the piping had taken place in the past. The pipe material appears generally to be Schedule 10 and Schedule 40 black steel pipe. In certain locations, it was noted that piping sections had been replaced with galvanized pipe. Typically, dry sprinkler systems utilize galvanized pipe (which is more resistant to corrosion) or Schedule 40 (which has a thicker wall than Schedule 10) pipe. Figure 5 below shows one of these repairs.

FIGURE 5: REPAIR WITH GALVANIZED PIPE

Additional locations showed other examples of repairs that had been attempted, see figures below:

FIGURE 6: CARDBOARD AND HOSE CLAMPS USED TO REPAIR LEAK

FIGURE 7: EPOXY ON GROOVE-LOCK COUPLING TO REPAIR LEAK

In discussions on site with facilities staff, it was noted that the compressors for the dry pipe systems operate at least three or four times per day to recharge the air within the sprinkler system. This indicates the presence of significant leaks within the system. Facilities staff additionally indicated that there are locations where leaking air can be heard behind or inside walls, however this was not able to be verified in the field. Evidence of numerous, small, ongoing leaks were noted throughout the building. Corrosion (primarily rust) was noted at joints and fittings in most locations in the building. These locations are particularly identifiable in areas where the sprinkler piping is painted white. Rust-colored spots were noted on piping, as identifiable in Figure 4 beneath the mechanical tee, as well as in Figure 8 below. It is particularly notable that the corrosion has continued beneath the paint, indicating that the corrosion is being driven from inside the piping. This is commonly caused by trapped water within the otherwise air-filled pipe, which creates an environment that increases the rate of corrosion.

In our opinion, should the current piping configuration (dry pipe system with significant trapped water) be maintained, the corrosion within the existing piping system will continue and will lead to more substantial piping failures.

The dry pipe systems located in the attic spaces, where able to be visually inspected, were not noted to have signs of leaks. These systems appear to have been installed as dry pipe systems, and presumably, were installed as to permit full system drainage. Sprinkler heads located on these systems – particularly the system over the library – have manufacturing dates of 1961. As these heads are older than 50 years, they are required by NFPA 25 to be tested to determine functionality, or to be replaced with new sprinkler heads.

FIGURE 8: CORROSION AT MECHANICAL TEE

Recommended Modifications to Fire Protection System

Based on the findings of the survey, the following modifications are recommended:

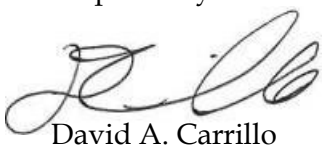
- Given the ongoing systemic corrosion problems, the existing fire protection systems and all associated components down stream of the incoming water supply flange should be replaced with new.
    - Dry pipe sprinkler systems should be installed as to allow full drainage of the piping
    - A nitrogen generator to prevent internal pipe corrosion should be provided for all new dry pipe systems
- Dry systems within existing attic spaces may be able to remain, with new sprinkler heads installed.
- Provide wet-pipe sprinkler coverage in all areas of the building that can continuously maintain at a temperature of 40°F (minimally the lower level and middle level).
- Provide dry-pipe sprinkler coverage in all areas that cannot be continuously maintain at a temperature of 40°F (minimally attic spaces, and may include the upper level).
- The building's new fire protection systems would be required to hydraulically support the following demands in each specified location, in accordance with NFPA 13, 2013 edition.
    - Classrooms, Offices, Hallways, & Dining Halls (wet-pipe): Light Hazard – 0.10 gpm/sqft over a remote area of 1,500 sqft
    - Storage Rooms, MEP Rooms, Kitchen Areas (wet-pipe): Ordinary Hazard Group 1 – 0.15 gpm/sqft over a remote area of 1,500 sqft
    - New City Archive Storage (wet-pipe): Ordinary Hazard Group 2 – 0.20 gpm/sqft over a remote area of 1,500 sqft

  - Attics (dry-pipe): Ordinary Hazard Group 1 - 0.15 gpm/sqft over a remote area of 1,950 sqft
- Provide tamper and flow monitoring of all sprinkler valves and components through the building's fire alarm system in accordance with NFPA 13 and NFPA 72.
- Provide a new backflow preventer between the system risers and the incoming water supply. Backflow should be sized based on hydraulic calculations.
- It is our understanding that the City Archivist has indicated that non-water based fire protection be utilized for the archive areas in order to minimize water damage. Should a clean agent system, such as FM-200, Inergen, or similar systems, be utilized in this area, a water-based fire protection system is still required as to comply with the "fully sprinklered" requirements of 780 CMR and MGL Chapter 148. It is our recommendation that a single- or double-interlock preaction system be provided within the archive areas to minimize accidental water discharge. Should a preaction system be utilized, the following would be required:
  - Separate preaction valve for the archive area
  - Sprinkler density and area would minimally require 0.20 gpm/sqft over 1,950 square feet
  - Smoke detection would be required throughout the archive areas to activate the preaction valve
- A standpipe system is not required for the building.

If you have any questions or concerns, please do not hesitate to contact us.

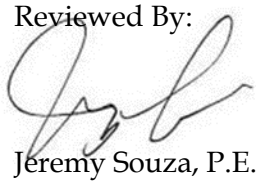
CODE RED CONSULTANTS

Prepared By:



David A. Carrillo

Reviewed By:



Jeremy Souza, P.E.

Appendix A: Simplex 4002 FACU End of Life Letter

Johnson Controls
6 Technology Park Drive
Westford, MA 01886

November 11, 2021

At Johnson Controls we know our customers are looking for products for their facilities that have a long useful life, and we are dedicated to supporting our Simplex fire detection system customers throughout that time. We do this by creating advanced, highly reliable solutions and providing service parts when available to help technicians keep our systems running smoothly for many years after they are installed.

Inevitably, as systems age, they reach a point where it's no longer possible to manufacture or obtain parts for them and the best choice to ensure the safety of the facility is to replace them with new solutions using the latest technology. We have worked to develop non-disruptive upgrade paths to simplify the transition from older Simplex systems to our newest life safety technology.

Launched in 1987, the Simplex 4002 system was formally discontinued in 1998 and has been replaced by the more modern Simplex 4007ES. Incredibly, Johnson Controls was able to continue to support the Simplex 4002 for an outstanding 19 years following end of life; however, at the end of 2017, Johnson Controls was forced to stop supplying Simplex 4002 service parts due to the discontinuation of critical components.

If a Simplex 4002 system requires service, it is extremely unlikely that repair parts will be available. This means the facility could be left without fire detection which could disrupt the facilities operation and require an unplanned emergency upgrade of the system. For that reason, we strongly recommend that any customers using Simplex 4002 systems immediately contact their local Simplex representative and work together on an upgrade plan for the systems as soon as possible.

Thank you for being a Simplex customer and giving us the opportunity to serve you.

Regards,

Tony Gryscavage, PE
Director, Product Management
Fire Detection Products

Fire Detection Products

The power behind **your mission**