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FIRE ALARM SYSTEM EVALUATION
900 NORTH STAFFORD STREET
ARLINGTON, VIRGINIA

Prepared for:

Alta Vista Condominiums
900 North Stafford Street
Arlington, VA 2 2031

May 1, 2008

W44724

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FIRE ALARM SYSTEM EVALUATION

The purpose of this survey was to review the existing fire alarm system throughout 900 North Stafford Street and prepare recommendations regarding the feasibility to upgrade existing components or replace the existing system with new equipment. A physical inspection of the system in the building was performed, along with a review of available service records. The information was reviewed in the context of current Code compliance, as would pertain to a replacement project, and should not be considered a deficiency for continued use of the existing system (unless otherwise noted), as the applicable criteria promulgated under the current Code has changed since the original installation. The existing system is only required to meet the standard of care for existing installations, until otherwise modified or replaced. No performance testing of the system was conducted.

Property: Ballston Metro Center (Condominium Building)
900 North Stafford Street
Arlington, Virginia

Inspection Date: April 8, 2008

EXECUTIVE SUMMARY

The fire alarm system at 900 North Stafford uart Street was reviewed to assess its overall condition as well as its compliance with current Arlington County and Virginia requirements for a new fire alarm system. Code compliance deficiencies with the existing system are present with respect to the most current Code criteria. This is likely the result of limited or no renovations in these areas since the more stringent criteria was incorporated in the Code.

Some issues/deficiencies of the existing system include the following:

1. The number and placement of existing speaker and visual notification appliances throughout some of the building appear to be deficient.

2. Notification and initiation appliances in most areas are not compliant with Americans with Disabilities Act (ADA) and code requirements.

3. Since the system is non-addressable, locating problem devices and performing maintenance is more difficult and time consuming.

4. There are no smoke detectors located outside the two exit stairs for actuation of the stairwell pressurization system.

5. The fire alarm system components are obsolete and many components are irreplaceable.

6. Existing duct detector locations do not meet current Code requirements.

7. Elevators do not contain a shunt trip function and there are no heat detectors within the elevator machine rooms.

GENERAL BUILDING INFORMATION

The condominium building at the Ballston Metro Center is located at 900 North Stafford Street in Arlington, VA. The condominium building occupies a lobby level, mezzanine level, and the 8th through 26th floors. The Lobby Level and Mezzanine Level are administrative floors. The 8th floor is a transitional floor is comprised of hotel back-of-house areas, management offices, community rooms, and condominiums. The 9th thorugh 26th floors are comprised by condominiums. An Engineering Penthouse is located above the Penthouse level. The Engineering Penthouse primarily contains mechanical spaces and one elevator machine rooms serving five elevators. There are two passenger elevators that serve the Lobby Level, Mezzanine Level, and the 8th through 26th floors. There is also one additional freight elevator that serves floors Lobby Level through the 26th floor. There are two enclosed exit stairs that serve the Lobby Level through the 26th floor.

The hotel occupies the 2nd through 7th floors underneath the condominium building. The hotel also occupies some back-of-house areas on the 8th and 10th floors.

Complete automatic sprinkler protection is provided throughout the building. The building contains a wet-pipe sprinkler system. There is one existing fire pump room located on the G3 level. The fire pump room contains a horizontal split-case fire pump, a fire pump controller, a fire pump power transfer section, and multiple wet-pipe risers.

EXISTING SYSTEM DESCRIPTION

HEAD END EQUIPMENT

The condominium building is currently provided with a hard-wired Simplex 4100 fire alarm control panel (FACP). The FACP is located in the fire control room for the condominium building which is adjacent to the main entrance vestibule. The main panel contains the voice communication system for occupant evacuation and firefighter phone communications. In addition, the FACP serves the visual notification appliance circuits for all floors. The FACP contains LEDs which indicate the following conditions: Zone alarm/trouble, main panel trouble, common alarm, common trouble, AC power, alarm

silence. The system is a complete hard-wired system with relay functions and building notification/initiation circuits.

The fire alarm devices on the Lobby Level and Mezzanine Level of the condominium building are controlled by the fire alarm system of the hotel.

There are two annunciators on the system. One annunciator (Annunciator 1) annunciates the entire building. The other annunciator (Annunciator 2) annunciates tamper switch locations. Annunciator 1 has controls and status for the emergency generator, fire pump, south tower pressurization and exhaust, Stair 5 pressurization, Stair 6 pressurization, north tower pressurization and exhaust, and Stair 5 door locks, and Stair 6 door locks. Annunciator 2 has no controls.

The fire control room contains two graphic annunciator panels indicating the following: Floor, zone, and initiation device type. There is another annunciator in the Fire Control Room that indicates tamper switches and floor location.

INITIATING DEVICES

Alarm and supervisory signal inputs include the following:

1. Manual Station.
2. Smoke Detector.
3. Residential Elevator Lobby Smoke Detector.
4. Heat Detector.
5. Sprinkler Flow Switch.
6. Duct Smoke Detector.
7. Hotel Elevator Lobby Smoke Detector.
8. Hotel Elevator Machine Room Smoke Detector (10^{th} floor).
9. Tamper Switch.
10. Fire Pump Flow.
11. Stair #5 Standpipe Flow.
12. Stair #5 Standpipe Tamper.
13. Stair #6 Standpipe Flow.

14. Stair #6 Standpipe Tamper.
15. South Standpipe Flow.
16. South Standpipe Tamper.
17. North Standpipe Flow.
18. North Standpipe Tamper.
19. Residential Pump Room Tamper (Level G-3)
20. Main Service Line Tamper (Level G-1)
21. Main Flow (Level G-1)
22. Heat Tape Fault.

Fire alarm initiation devices are arranged based upon Table 1:

Type of Device	Typical Locations of Device
Smoke Detector	System connected area smoke detectors are located in the following locations: corridors, fire control room, elevator lobbies, elevator machine room (EMR), and electrical closets.
Duct Smoke Detector	Duct smoke detectors are on the supply side of each air handling unit. There are no duct returns.
Manual Pull Station	Manual pull stations are typically located adjacent to the entrances to the exit stairs at each level, and at the exits to the exterior.
Automatic Sprinkler Signals	Fire pump room control valves, dry-pipe valves, and the sprinkler system supplies at each floor all have valve supervisory switches. The main fire service line, fire pump, dry-pipe valves, and risers all contain waterflow switches which are monitored for alarm status. The wet sprinkler system risers contain waterflow and tamper switches at each floor landing in each stairway.

Table 1: Type and Location of Initiating Devices

ALARM SYSTEM OUTPUTS AND CONTROL FUNCTIONS

Alarm signal outputs on the annunciators include the following:

1. Stair door lock release for all stair doors.
2. Elevator recall. (Primary and Alternate).
3. AHU Shutdown and manual activation.
4. Sounding an emergency voice/signal communication on the fire floor, floor above, and floor below (Selective Evacuation).
5. Flash visual notification on the fire floor, floor above, and floor below (Selective Evacuation).
6. Manual override outputs for voice communications and individual floor speaker circuit selection.
7. Firefighter communication system.
8. Stair pressurization.
9. Smoke exhaust and pressurization fan activation and shutdown.
10. Fire Pump Control.
11. Generator Control.

Alarm notification is arranged based upon Table 2:

Type of Appliances	Typical Locations of Appliances
Speaker and Visual Appliances	Speakers and strobes were located in random corridor areas. Visual devices are also located throughout most common areas. Speaker-only devices are also located in each condominium unit, elevator cabs, and in each stairway. Although testing was not conducted during this visit, it appears that additional notification appliances need to be provided in these areas to meet current Code requirements.

Table 2: Type and Location of Notification Appliances

The interface of the fire alarm system to building systems is provided in Table 3:

Type of Interface	Function
AHU Shutdown	The fire alarm system provides shutdown functions for the AHUs.
Door Release	The fire alarm system provides control functions to release Stairs 5 and 6 doors.
Firefighter Phone System	A firefighter phone communication system is provided throughout the building. Firefighter phone handsets are located in each elevator cab, at each stair door landings, elevator machine room, and the elevator lobby on every level.
Elevator Recall	The fire alarm system provides control functions for primary and alternate recall.
Manual speaker override	The FACP has a manual speaker override which contains a microphone for manual emergency messages and a panel containing speaker circuit selection for allowing additional floors to be evacuated.
Stair Pressurization	The fire alarm system appears to provide control for stair pressurization fans for each of the exit stairs.
Smoke Exhaust and Pressurization Fans	Smoke control fans are provided for the south and north residential towers and Stairs 5 and 6 and appear to activate on any alarm. The annunciator also has controls for the corridor dampers on each floor.
Fire Pump and Generator Control	The fire alarm system appears to provide manual control of the fire pump and generator.

Table 3: Control Functions with Interfaced Building System

CONCERNS WITH THE EXISTING SYSTEM

Several concerns were observed with the system, with respect to operator use, as follows:

1. The system is currently of a non-addressable type. This increases the time required to locate a potential problem with an initiating device or an actual fire incident.

2. The Simplex 4100 is considered obsolete and cannot be reliably serviced, as the product has been discontinued by the manufacturer.

3. The smoke detectors located throughout the facility are most likely original equipment. Since most of these devices appear to have not been replaced recently, these original devices are considered unreliable due to age, and should be replaced under any new system implementation. Standard loss prevention data places a maximum operational life of 15 years on such electronic components.

Additionally, since the installation of the main building system, newer Code requirements have mandated the provision of additional devices for alarm systems that were not required at the time of the system's installation. These findings with the system are listed as follows:

1. The corridors and common areas do not contain ADA compliant notification devices in sufficient number to meet current Code requirements. In addition, due to the existing visual device locations, many areas do not meet the coverage requirements and line of sight for common areas. Additional speakers may also be required in common spaces and in condominium units in order to comply with audibility and intelligibility requirements.

2. The smoke detectors in the corridors do not appear to meet current spacing requirements due to the location of the corridor lintels. Additional smoke detectors may be necessary.

3. Notification appliances need to be provided in the Mechanical Rooms and Elevator Machine Rooms due to the high ambient noise. Presently, there are no notification appliances within this location.

EXISTING EXPANSION OR MODIFICATION CAPABILITIES

The Simplex 4100 panel is obsolete and should be replaced. Future repairs with this panel are not practical. The smoke control and generator control panels appear to be original and should also be replaced with the head-end equipment. The smoke control panel and auxiliary panel can be combined within the new head-end equipment instead of utilizing separate panels. Since the head-end panel is to be replaced, a new firefighter master phone controller will also need to be replaced. The existing firefighter phone circuits and remote phones serving the floors can be reused with a new Simplex system.

Existing wiring for the speakers may be reused with the new voice communication panel. The existing wiring configuration should be closely examined for improper wiring configurations (T-Tapping) or deterioration. Where new speakers need to be added, the existing speaker circuits should be tested to determine if they have spare capacity.

Furthermore, the existing visual device layouts on most floor are significantly deficient with respect to quantities necessary to meet current code requirements. In addition,

most areas will need ADA compliant visual devices. Any new or relocated devices can be tied into the existing circuits so long as a functional load test is performed on each circuit in order to prevent an overload or exceed the maximum voltage drop.

All initiation, monitoring, and control devices will be replaced with the new head-end equipment. Since the original FACP is a hard-wired system, the original devices would not be compatible with a new addressable system.

GENERAL FIRE ALARM SYSTEM REQUIREMENTS

Any new fire alarm and detection system or voice system upgrade will be required to comply with current codes, including the International Building Code 2003 edition (IBC-2003), along with the Virginia Uniform Statewide Construction Codes and Arlington County amendments.

The 2003 IBC requires that smoke detectors connected to an automatic fire alarm system be provided for the purpose of elevator recall. Smoke detectors are still required in all elevator lobbies. Smoke detectors are also required at the entrance of each stair for exit stairs with stair pressurization systems.

Upon alarm actuation, the fire alarm system must be capable of initiating notification devices on the fire floor, floor above, and floor below, closing any held-open fire doors, unlocking secured stair doors, shutting down associated HVAC units, recalling elevators to their assigned floors, signaling annunciators and networked FACPs.

Audible and visual alarm notification appliances are required to be automatically activated by smoke detectors, sprinkler waterflow devices, manual pull stations, and other approved types of detection devices or suppression systems (IBC 907).

Audible notification appliances are required to sound in every occupied space in the building and provide a sound pressure level 15 Dba above the average and 5 Dba above peak ambient sound level throughout. The minimum sound pressure levels should be 90 Dba in mechanical equipment rooms and 70 Dba in all other areas (IBC, Section 907.9.2). Visual notification appliances are required in all public and common areas of the building (IBC, Section 907.9).

UPGRADE OPTIONS

The fire alarm industry has changed dramatically since the original selection and installation of the Simplex 4100 panel. In the 1980's the industry began to embrace computer technology in the use of fire alarm systems. The complex regulatory process in the fire alarm industry has always kept the industry on the backside of the computer technology curve. The time necessary for product design, testing, UL approvals, sales

and marketing often outdates the technology, from a computer perspective, before it is available in the marketplace.

Since computers entered the fire alarm business most of the major manufacturers have provided technological upgrades on a 3-5 year basis. Maintaining backward compatibility of newer technology with existing systems has been difficult. Some manufacturers have done a better job at maintaining product line continuity through backward compatibility than others.

The driving force in the obsolescence of current market fire alarm equipment is the availability of replacement parts because of the aging technology components.

Corporate mergers have also occurred in the fire alarm industry in recent years. Historically in the industry, product development and marketplace position of the major manufacturers has varied based upon changes in ownership. There are currently four equipment manufacturers that, in our opinion, manufacture product and provide adequate support in this marketplace to handle the nature and complexity of the fire alarm system replacement at this facility. Those companies are:

1. Fire Control Instruments (FCI) - NetSolo product line.

2. Edwards Systems Technologies (EST) - EST3 product line.

3. Siemens - Cerberus Pyrotronics (XLS) product line.

4. SimplexGrinnell - Simplex 4100U product line.

Our report will not recommend a specific manufacturer or specific product distribution methodology, however, we would suggest that prior to entering into an agreement with any company for the replacement of all or part of the fire alarm system, that the bidders provide references from facilities of similar size and scope and that those references be checked for Client satisfaction. In our experience, we have seen a wide divergence in the quality of service provided by each of the distribution methods in various marketplaces.

FIRE ALARM TECHNOLOGY

STATUS OF EXISTING TECHNOLOGY

The Simplex 4100 fire alarm systems were first introduced in the marketplace in the 1980's. At the time, it represented conventional hard-wired fire alarm system technology. Its technology and modular design was consistent with applications engineering flexibility for the fire alarm industry at the time.

The system, as installed, utilizes two-wire smoke detection. Two-wire smoke detectors receive their power and transmit the alarm over the same pair of wires. These detectors create a change in resistance on the circuit as they approach alarm. At the alarm threshold the control panel recognizes the change in resistance in the circuit and initiates the zone output to initiate the alarm output functions.

In the late 1970's and early 1980's building codes began to rely heavily on smoke detection as a method of increasing life safety in buildings. This wide-spread installation of smoke detection created new problems for the fire service. The fire service began responding to an inordinate number of smoke detector alarms that were not caused by fire conditions. By the late 1980's the fire service demanded improvements in the industry to minimize the number of false and nuisance alarms (nuisance alarms are caused by products of combustion that are not indicative of a hazardous condition such as cigarette smoke or engine exhaust fumes; false alarms are alarms caused by other sources).

STATUS OF CURRENT TECHNOLOGY

New fire alarm systems for high-rise and low-rise buildings (new and retrofit) are computer-based. These systems often use multiplexing to allow the transmission of multiple signals over a single pair of wires.

The use of multiplexing is not a new concept in the fire alarm industry. Municipal master box systems and early central station reporting systems sent multiple signals over a single pair of wires by using electro-mechanical coders to differentiate between the signals since the early 1900's.

In the late 1980's and early 1990's the fire alarm industry embraced computer technology to use computer-based multiplexing. Using a computer-based fire alarm system, hundreds of devices (the exact number varies by manufacturer and data communication protocol) are on a single pair of wires. The computer differentiates between each circuit by a unique digital identification assigned to each circuit in the system. On the multiplex side of the system, supervision of the installation conductors is not done electrically, as it is in older technology. Rather, it is done electronically through a poling and response process between the central processor and each of the connected devices.

The computer-based technology allowed for substantial changes in the way smoke detection operates. These changes resulted in a tremendous improvement in the number of false and nuisance alarms.

Modern fire alarm control panels have the ability to determine when a smoke detector has become too sensitive and likely to false alarm. These systems can also detect if a sensor has become too insensitive and not able to provide proper response. Detection

of either of these conditions will result in a trouble indication with specific information about the sensor and the fault condition.

Coupled with the improvements in the control panel technology, improvements have also been made in detection technology. Detectors are now available that respond to multiple fire signatures. In many systems, the exact fire signatures anticipated in the hazard area can be programmed at specific threshold levels. This also allows the ability to ignore other fire signatures that may be present in the environment but do not necessarily represent a hazardous condition. The currently available technology will allow for automated testing of detector sensitivity. It will allow for automatic notification regarding sensors in need of attention. It will provide more specific fault isolation information from fault conditions. This will result in fewer false alarms by improved sensor technology and specific algorithms designed to reduce false alarms. Detector alarm thresholds can also be adjusted based on ambient environment and/or time of day. In addition, many of these detection systems provide the ability to re-verify smoke detector signals prior to initiating the alarm sequence.

There have been some changes in the way the voice alarm portion of modern fire alarm systems operate. The amplifiers will receive one or more audio signals from an audio bus that originates at the fire alarm system control unit. Each audio bus represents a unique channel as referenced in earlier technology. Digital switching through the computer-based portion of the fire alarm system is utilized to switch the appropriate bus circuits on and off. The distributed technology provides a much greater level of reliability for the system. There is no single point of failure. Modifications or changes to system configurations are easier because circuitry only needs to be run to the distributed amplification location.

The most recent developments in audio distribution for fire alarm systems utilize a technology where a digital message is transmitted over the same communications bus that transfers the fire alarm network information. This reduces the amount of wiring during installation and provides multiplexing of the digital voice message over the network communications.

These changes in system technology have produced increased flexibility and reliability in the industry, but it also increased the level of expertise required to service and maintain the systems.

NEW SYSTEM ARCHITECTURE

GENERAL

Concerns noted on pages 6 and 7 of this report need to be addressed as part of an upgrade/replacement project.

1. Fire safety function interfaces will remain as currently provided, such as automatic-release of locked doors for firefighter access, floor smoke control, stair pressurization, and elevator recall functions. However, these safety functions should be adequately tested.

2. It is noted that throughout the building on certain levels, additional ADA compliant strobes and speakers are required. Existing notification wiring may be re-used but should be closely examined for code compliance.

3. Elevator lobby smoke detectors, smoke detectors in elevator machine rooms, smoke detectors in the corridors, and smoke detectors in electrical rooms shall be replaced with new addressable devices.

4. All monitor and control devices utilized for the fire alarm system shall be replaced with addressable devices.

5. All manual pull stations shall be replaced with new addressable devices at ADA compliant heights.

6. Existing firefighter telephones and circuit wiring may be used with the new system panel if Simplex equipment is used. However, it should be noted that the phone system may not be compatible with some fire alarm manufacturers.

7. The existing Simplex 4100 system and firefighter phone controller needs to be removed and replaced with a new addressable system.

In addition to the upgrade options above, Arlington County will also require the fire alarm system to meet the survivability requirements of NFPA 72. This will require a new fire alarm system riser.

Estimated cost for the replacement and addition of the previous list is given in the last section of this report, along with an alternative budget estimate for replacement of the entire system with a new, fully addressable system.

COST ANALYSIS

Work rules such as after-hours construction will significantly impact overall job cost. However, we have provided a rough estimate based upon the following assumptions:

1. Flow switches will be replaced only as necessary.

2. Existing wiring and booster panels are planned to be reused.

3. ADA compliant strobes and circuits are planned to be reused.

4. The approximate cost of $500 will be used as the approximate cost for a new fire alarm device (parts, installation, and programming). New devices are to be tied into the new addressable circuits.

5. A cost of $200 will be used for the installation of a new wall mounted ADA compliant strobe or speaker (parts, installation, and programming). New devices are to be tied into the existing circuits following a system load and voltage drop test. Cost includes additional circuits, if required.

The cost analysis does not include estimates for design and construction administration or the cost of installing shunt trip breakers. Design and construction administration are anticipated to be in the range of $60,000 to $80,000.

For the purpose of phasing the project, the upgrade should be done on a floor by floor basis.

FLOOR BY FLOOR UPGRADE

A floor by floor upgrade consists of the installation of new devices on a floor by floor basis while the original system is maintained online. New conduit shall be installed and the new head-end equipment and risers are installed first. The new panel is tied into the original panel as a temporary means to generate a general alarm condition. As each floor upgrade is completed, the new circuits are tied into the new system riser. Once all floors are online with the new system, the old system is removed. Because of the stringent requirements involved in a full building firewatch for a long period of time, RJA recommends the floor by floor upgrade option.

The cost for a floor by floor upgrade includes the programming and temporary tie in of the old and new systems. The total cost will be approximately between **$700,000** and **$1,000,000**. This cost was calculated assuming that the existing speakers, firefighter telephones, and all associated circuits will be reused.

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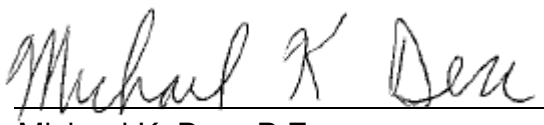

May 1, 2008

Michael K. Derr, P.E. Date

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