EVALUATING THE NEED FOR MODERN FIRE STATIONS WITHIN THE ALEXANDRIA, VIRGINIA FIRE DEPARTMENT

Executive Development

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Appendices Not Included. Please visit the Learning Resource Center on the Web at http://www.lrc.dhs.gov/ to learn how to obtain this report in its entirety through Interlibrary Loan.

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Abstract

The problem is that the Alexandria Fire Department has exceeded its capacity of available space in all of its eight fire stations. The purpose of this action research project is to bring to light the extent of the problem and the need for the department to develop a long term plan to address the need for newer facilities.

The following questions were asked: 1) how does the existing station locations meet department's goal of providing an appropriate response time? 2) How is the current distribution of resources in the department affected by existing locations? 3) How do the existing facilities meet the operational and environmental needs of the department's mission and its employees?

The research process included site visits, surveys and computer modeling. As a result of the station visits and response molding it was determined that the existing stations needed to be upgraded.

It was recommended that the department look at creating a long term plan to address the station needs.

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Introduction

Within the past several years, the Alexandria Fire Department has increased the number of employees and response vehicles. Because of the difficulty in purchasing apparatus to fit in the existing stations, most reserve apparatus, except for the medic units, have to be kept outside of the station and are subjected to the weather and possible vandalism.

The stations have maximized their utilization of the available space in their facilities and have found that there is no more room for expansion. Not only are the living conditions cramped, making a less conducive work environment, but the storage situation has become so inadequate that in some stations the basic station supplies and equipment, and necessary emergency equipment, has to be stored in outside sheds and containers.

A descriptive research methodology was used to examine the situation and identify the reasons why the department needs to develop a long-term plan specific on how to improve the existing fire stations. The resultant document could then be used to assist the City Council in understanding the needs of the fire department and seek to provide funding for the project. The following questions were posed in conjunction with the research:

1. How do the existing station locations meet the department's goal of providing an appropriate response time?
2. How is the current distribution of resources (i.e.; engines, trucks, medic units and rescue) in the Alexandria Fire Department affected by existing locations?
3 How do the existing facilities meet the operational and environmental needs of the department's mission and its employees?

Background and Significance

Alexandria, Virginia is a city of only 15.6 square miles located along the Potomac River, just across the river from Washington DC. This colonial port was incorporated as a city in 1749. At that time the city consisted of only 743 acres of land; however, fire protection was important to the new settlers in this new city. Friendship Fire Station, a volunteer department of which George Washington was a member, was the city's first fire department. Over the next two and half centuries, the city has continued to grow and expand. So too has its need for adequate emergency services.

In 1976 the last station was constructed by the City of Alexandria, Station 8 located in the Landmark area. In the past, the department has performed some renovations to the stations in an attempt to address changes, and wear on the building as they have occurred over the life of the station. Most of thee changes have been to address additional services that have been incorporated into the station such as EMS or upgrading interior finishes. The headquarters station on Powhatan Street, received a major renovation and expansion in 2000. This project included the an addition of a third apparatus bay, space for station personnel and new office space for the administrative staff to include the a new communications center.

The Alexandria Fire Department operates eight engines, three truck companies, five medic units, six specialized response units, and four command staff personnel; all are housed within its eight stations. The oldest operating fire station in the department is Station 1 which was constructed 1912. The construction and expansion of new stations continued over the next six decades, with four stations being constructed in the 1950's, shortly after the city annexed 4800 acres of land on the west end of the city. At that time, it was common practice, for cities to build fire stations with two apparatus bays.

Over the past three decades the department has experienced a great deal of operational growth with little expansion to its facilities. In 1976, the department operated eight engines, three trucks, two chiefs and two ambulances. Today, the department has expanded to incorporate EMS operations, hazardous materials response, technical rescue responsibilities and marine operations unit. With the increase in the department's operational capability, it too has also had to increase its administrative, logistics and support functions to meet the change needs of the city.

Fire apparatus are wider than they were when the stations were built. According to Tom Shand, noted apparatus enthusiast and Sales Engineer for American La France, "fire apparatus today, is much larger it was ten years ago" (Shand & Wilbur 2002). According to Shand the average height of an engine was a little over nine feet in the early 1990s, where the average engine height is now over ten and half feet high in most apparatus specifications (Shand, personal). The problem of larger apparatus is not just limited to pumpers; aerial apparatus, specialized response vehicles and ambulances are all designed larger then their counterparts of years ago. These larger vehicles present challenges. For example, the average door height in the department is 10 feet 5 inches and needs to accommodate apparatus that is the same size or larger. Aside from the height, vehicles are now being designed longer, wider and much heavier.

Due to the stations' limitations, they have not been able to keep up with the growth expected in modern fire stations. All of the stations built prior to 1976 were designed to house only men. Bunkrooms were large dormitories with gang showers. Since that time the number of personnel assigned to the suppression and EMS division has increased by 14 personnel per shift. Presently, women make up 29% of the department's workforce in the field.

Like many first ring central cities, Alexandria has been developing many of its land bays. One such area that has seen an increase in development has been the Eisenhower Valley area, first developed for flex warehouses and light industry. That area's plans for growth include numerous apartment and high rise buildings. While simply the growth of the area may be of concern to some, the largest problem that affects the response times to this area is the limited access on both ends of this six mile stretch of road. . On several occasions the city has attempted to construct a connector road from Eisenhower Avenue to Duke Street; however, those attempts have failed. City officials already have recognized that at some point a fire station will have to be constructed in the area.

This project is being performed in conjunction with the completion of the Executive Development Program at the National Fire Academy. As a future leader of the fire service, an executive leader must recognize the need for change, understand the changes that are occurring within the organization, and seek the most effective methods to effect those changes. The purpose of this paper is to examine the impact on service delivery and its impact on the safety and welfare of firefighters and the community.

Literature Review

Literature review consisted of seeking information from trade journals, books and other applied research projects (e.g., the resource center at the National Fire Academy, George Mason University and in the internet). Additional literature review included examination of maps and records of the Alexandria Fire Department

In searching for information pertaining to station locations and its impact on older cities, there is a limited amount of literature pertaining to fire station renovations or the impact older structures have. There are however, several documents and guidelines which suggest the

placement of fire stations. The National Fire Protection Association (NFPA) and also the Insurance Services Office (ISO) both offer suggestion or guidelines as to the placement of fire stations.

According to the *NFPA 1710 the Standard for Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments* published in 2001; discusses response time rather then actual station locations. The document goes on to further suggest that the first arriving engine should arrive on the scene within five minutes of the alarm. Furthermore, it identifies that the balance of the response should not assemble any greater then eight after the initial dispatch. For medical emergencies it was identified that for advance life support (ALS) emergencies a first responder should be on the scene within 4 minutes with personnel trained in basic life support arriving in five and the balance of the response being an ALS trained person arriving in eight.

The Insurance Service Office (ISO) has taken the approach of suggesting that "stations should be located within one and one half road miles from a point" (ISO, 1999, p. FD-2). One of the problems with ISO, one and half mile travel from the travel point is that it is theoretical. In some cases, some departments create a mile and half circle around a station. With the advent of computer modeling and placing specific perimeters in the computer, which represent actual conditions, a more precise projection can be accomplished.

The Alexandria Fire Department has adopted a policy of five minute response time. This response time is in an established department Standard Operating Procedure (SOP) SOP # 2.3.14 titled Response and Turnout Times; which was adopted in 1993. The background of the SOP cites both the need for a rapid response to maintain the department's procedure, to

maintain its ISO rating, and the American Heart Association (AHA) recommendation for five minute response to Advance Life Support (ALS) emergencies.

Certainly one of the biggest impacts that are affecting the need to examine new stations in the Alexandria is that fact that it is getting more and more difficult to purchase apparatus that fit in the stations. To understand why fire apparatus has gotten to be larger then what they were a decade a go, literature suggests the apparatus changes are being driven by the amount of equipment and personnel that are being carried on the apparatus. "Engines are no longer, just carrying hose and water" according to William Peters (Peters, 1997); as he was describing how the role of fire apparatus has changed. The author further provides examples on how the roles of engines have changed. They are now expected to provide extrication, EMS, hazardous materials mitigation and carry enough equipment to cover everything. While not conceived as a requirement of additional storage space on apparatus in 1997, many apparatus now carry some level of protection or response to weapons of mass destruction (WMD). Moreover, more departments are looking at creating combination apparatus such as tanker/engines, rescue engines and quints.

Additionally, Tom Shand has authored several articles and books pertaining to fire apparatus. In an article that he wrote for Fire Engineering along with Michael Wilbur they discusses not so much about the mission of the today's fire apparatus, but more of the engineering reasons why vehicles have gotten larger. While he does concur with Peters as it relates to the amount of stuff carried on an engine today he also adds that larger vehicle require larger components (frame rails, motor, drive train and axels). Shand reports that "apparatus cabs have become more complex; with an increase emphasis on ergonomics, safety and comfort to the passengers" (Shand, 2002). Additionally, he points out those changes in

the NFPA 1901 have placed a heavier emphasis on vehicle safety features, which too have contributed to the some of the design features.

Fire stations are the focal point of many communities. One of the issues that the existing stations have become so over crowded is that they were designed in an era when the fire service was predominately a male profession. Literature suggest the need for them to be gender neutral, provide a safe working environment and allow for an ergonomically and comfortable work space. In conducting the research several themes kept on coming up during the research and that had to do with restroom facilities. According to Woman in the Fire Service (WFS) website they state that "poor facilities can lead to poor performance and an increase in the occurrence of harassment" (WFSI.org, 2004). Trying to adopt the necessary renovations to older buildings can be difficult, but not an excuse.

Research looked at the requirement of newer station. The United States Fire Administration published a manual on Safety and Health Considerations for the Design of Fire and Emergency Medical Service Stations. The manual provided several ideas and suggestions on what to consider for the design of a modern fire station. This assisted in development of the survey that was conducted. Additionally, it identified many of the Occupational Safety and Health Administration (OSHA) as well as American with Disabilities Act (ADA) rules and regulations that affect many station designs. The manual suggested station designs need to flexible and be able to adjust to future growth.

Moreover, the point that was driven and given the departments current situation the authors discuss, "what is often designed and built to meet the department's current needs, often periodically fall obsolete" (FEMA, 1999). That particular section talks about how

stations are often renovated over and over and that at some point you get no return on your investment.

Procedure

The different methods of data collection that were utilized in preparing this project were literature review, interviews, surveys, observations and computer modeling.

Relevant literature was gathered from magazines, manuals and other Applied Research Projects from the resource center at the National Fire Academy and the library at George Mason University, during the time frame of May and June 2004. Supporting documentation was important for several reasons; the first was to understand what changes have occurred in the fire service since the time of construction of the Alexandria stations, and second was to find collaborative materials to support the points of the research project.

Next, each of the eight department's facilitates were visited during the time period of May 17 through May 19, 2004. These station visits consisted of two parts, the first was to visually examine the stations and complete paperwork to document the facilities. The second component of the visit was to give the station commander a survey which reflected the station environment as it related to the ergonomics of its living and working space. While each station is has three captains assigned to manage the station on their respective shift, each station has a Battalion Chief who is assigned to as the Station Commander for station oversight and management.

The purpose of the survey was to determine those factors associated which reflect the use of the station and living conditions that exist in the station, going deeper into those issues, which could not be observed surveying the physical layout. Additionally, the survey asked operational questions about the stations function within the organization, apparatus response,

primary response area and its target hazards. Last the survey asked about what impediments exist within the physical layouts of the buildings that impede the company's ability to function.

Finally, working in conjunction with James Grant, the department's CAD specialist several response models were created utilizing each of the existing stations and apparatus response. The program, ArcGIS Maps, generated the response for each of the stations' 5 minutes and 7 minute responses. Maps were generated to identify each of the engines, trucks, and medic units' primary response areas.

Limitations

While the computer modeling program incorporates the average travel speed of the roads and controlled intersections, it does not take into account traffic patterns and congestions often encountered by emergency response personnel.

Results

Question 1

How do the existing station locations meet the department's goal of providing an appropriate response time?

After reviewing the data, it was determined that the department does meet a five minute response time in approximately 87% of the city. There were a few small pockets which are difficult to gain access to, so small that building a station to address that could not be justified. However, one area that did not meet the response time was the Eisenhower Avenue Corridor, commonly referred to as Eisenhower Valley.

The Eisenhower Avenue Corridor is a four-mile, east/ west road on the southern side of Alexandria, parallel to the Capital Beltway (I-95). The corridor development is planned as a diversified, mixed-use area, with high density commercial development. Development of the Eisenhower corridor began in 1973; however, most of the development has been centered on small warehouses and a few office high-rises. It has only been during the past few years that developers have taken an interest in developing the area. Current zoning permits for high density; office, hotel, retail, and residential uses with more than 60 acres available for development in the eight different parcels. Aside from the increase in growth, access to the area is limited to two roads at either end of Eisenhower Ave. This results in difficulty for responding units trying to meet the five-minute response time. One problem, noted by ArcGIS program, was that it would allow units from Station 7 (Duke Street) to utilize Bluestone Road to Eisenhower Valley area. The road has yet to be built, nor are there any plans in the near future to allow it to be built, however, it continues to show on city planning maps as an existing road.

The city has recognized that fact that this area not would be difficult to service, but that the increase in both residential and office space will significantly increase the demand for service in the area. However; due to public outcry, several attempts in the past to connect Eisenhower Avenue and Duke Street at Bluestone Road have failed. If the connector was to be constructed, Station 7 would be no more then a half mile from the intersection.

Aside from the Eisenhower Avenue Corridor, it does appear that the locations of the city fire stations are situated in such a fashion that they provide adequate protection. It was also interesting to note that a large percentage of the city had a large amount of overlap in the five minute response criteria. Some of the stations have limited or no property to expand.

The overlapping response area could be beneficial in relocating some stations, within their primary response areas.

Question 2

How is the current distribution of resources (i.e.; engines, trucks, medic units and rescue) in the Alexandria Fire Department affected by existing locations?

First, it is important to define adequate. For the purpose of the research project we have accepted the response criteria of five minutes for initial on scene time as defined by NFPA 1710 and the department's SOP. The standard states that additional units should assemble on the scene within a six to eight minute response time. Engine companies are the primary initial responders to all emergencies, excluding basic life support calls unless the EMS unit is delayed. Since every fire station is assigned an engine company, it can be concluded that the conclusion as question 1 would apply to each of the eight engines.

The department operates three aerial apparatus from Station 3 (Cameron Mills), Station 4 (Powhatan Street) and Station 8 (Landmark). Utilizing a seven minute response time, it was determined that the department is capable of meeting the response objective 90% of the time. Again, it was identified that the Eisenhower Avenue Corridor was outside the seven minute response time. Furthermore, this area is zoned for dense residential and highrise buildings.

It was determined that the truck companies that were located at Stations 3 and 8 were properly located, with little overlap. After reviewing the data, it was determined that Truck 204 needed to be relocated to Station 5 (Cameron Street). A relocation of Truck 204 to Station 5 would increase to 98% of the city being adequately covered with a truck company in seven minutes.

Truck 204 was located at Station 5 for a period of thirty years ending in 2000. However, the department was unable to find a manufacturer capable of building an aerial apparatus that could fit in the station; due to its restrictive door height, a requirement of NFPA 1906 requiring enclosed tiller cabs and the vehicle weight on the station floor. As a result a major renovation and addition was completed on Station 4 in 2000 to incorporate a new bay for the new ladder truck and expanded office space.

The majority of Truck 204's responses occur south of its existing station, towards the center of the Historical Old Town portion of Alexandria and part of Eisenhower Valley. The return of the ladder truck back to Station 5 would position the aerial device in the center of four stations and would increase its response capability. Modeling presently suggests that presently, T204 has a five minute response time to only 81% of its first due area, the relocation of the truck to the new location would increase the response time to a 95% five minute coverage.

Since the department uses a two-tier dispatch system in which critical advance life support emergencies get a response of the closest suppression unit, the department meets adequate service coverage from its existing stations as noted by the first question. According to NFPA 1710, a four or fewer minute response time is necessary for first responders and eight minutes for ALS.

Additionally, the department houses several specialty units which include a hazardous materials response team, boats, light and air unit, and a rescue company. There are no existing standards for responses of these specialty units; however, the department is moving to incorporate standardized operating procedures with its neighboring jurisdictions of Arlington and Fairfax County. On commercial buildings, high hazard structures and high rise structural

assignments, a rescue company is dispatched along with the other suppression units. Given that there are no existing standards; one could draw a parallel to a truck company response time of seven minutes.

In examining the existing locations of a rescue company located at Station 6, only approximately 65% of the city is covered. Additionally, Rescue 109 (Arlington County) is located two miles north and Rescue 426 (Fairfax County) is located four and half miles south of Station 6. By relocating the rescue company to Station 7, the coverage area would increase to 81% and the automatic aid companies from Arlington and Fairfax County could cover the remaining areas, to have complete coverage in the city within seven minutes.

Question 3

Do the existing facilities meet the operational and environmental needs of its mission and its employees?

All of the stations are at capacity. However, fire service personnel do what fire service personnel do best -- adapt and overcome. One can easily see that in terms of apparatus bay space, the department has run out of room. Over the years the department has attempted to address the changing needs of the department by modifying the stations in an attempt to meet needs. While the buildings met code when constructed; many of the buildings lack any form of basic life safety equipment. Also, most lounge and eating areas are restrictive.

Six of the eight stations only have two bays. The remaining two stations; Station 2 and Station 4 both have a third bay after additions to the buildings in 1950 and 2000. In the case of two medic units, a response vehicle is located behind the medic unit requiring that the medic unit has to pull out of the station in order to making way for the vehicle behind to respond to calls. According to Richard Myer, a paramedic assigned to Station 8, “This is very

frustrating, to spend most of the time getting up in the middle of the night to move the medic unit so that the engine can respond." Both Station 6 and Station 8 were not initially designed to house EMS units.

The depths of the apparatus bays range from 47 to 66 feet. On average, width of most stations apparatus bays are 24 feet. These close quarters make it difficult to move between vehicles. It was noted in several stations that there was about 18 inches between the wall and the side of the apparatus. Regarding the average square footage of bay space, it was determined that both of the bay stations had an average of 1500 square feet of bay space available, while the stations that have 3 bays have 2048 and 2684 square feet of space. To demonstrate how tight the apparatus bay is; Station 2, the hazardous materials station, houses a medic unit, a hazmat support vehicle, an engine, a hazardous materials unit and a utility vehicle. Vehicles are stacked two deep with a foot between vehicles. The foot print of the apparatus consumes 1743 square feet, without taking into account structural components that exist in the bay or other items such as telephone and storage cabinets and gear racks.

The department maintains a front line fleet of 22 frontline response vehicles that must be ready to respond from all eight stations. Additionally, the department must maintain a fleet of four reserve engines, four reserve medic units, and a reserve aerial ladder. Presently, there is only enough bay space in the stations to allow one reserve engine, and two medic units to be maintained inside a fire station. Two other medic units are maintained in a garage at the department's training center. This leaves the three reserve engines and ladder truck outside subjected to the weather and for security reasons are not kept in a position where they can be rapidly deployed if needed.

Sleeping space in the station is starting to become prime real estate, in some cases what used to be individual bunkrooms of 10 feet by 12 feet are now sleeping 2 personnel in order to create enough space in the station. Sleeping areas in the fire stations range from dormitory style to individual bed rooms. Specifically, the problem is worst for EMS personnel having to share small cramped quarters with three beds and lockers. Only Station 7 has separate female bunk space for female paramedics.

The department has attempted to modify some of the stations to incorporate separate shower areas; however, it is a rudimentary fix, which is not much larger then a closet. One such modification at Station 5 created a bathroom space that is only 6 feet by 3 feet. Many of the stations have had to utilize a signage policy to identify whether or not a restroom or shower facility is or is not occupied by a female member of the department. Last, only Station 4, which was recently renovated, provides the only restroom facilities that are ADA compliant.

Living and working space in the stations are cramped. Kitchen area and lounge areas may be the same space. In many cases, the only way a company officer can have some private time to counsel an employee is by taking the employee to the bunkroom. According to the Lieutenant Mike Garcia, the department's facility manager, "the biggest issue with the most of the stations is the kitchens." They are constantly upgraded and equipment continues to break. In most stations the kitchen area is small, not much larger then what you would expect in a residential unit. Due to the size of the kitchens, it is difficult to upgrade the kitchens to an industrial kitchen.

Last, the department is concerned about the life safety issues that exist within the station. In the early 1990s the department installed a diesel extraction system in all the

stations, after concerns of carcinogens in the environment from the apparatus exhaust. However, since many of buildings were built before stringent fire protection codes. Only one of the stations has any form of fire suppression or detection system other then battery operated smoke detectors.

Discussions

After completing the assessment and the related literature review it is clear that the department needs to develop a strategic plan to address the station needs in the city.

It has already been acknowledged by city officials that an additional fire station needs to be constructed in the Eisenhower Corridor; this event may be the perfect opportunity for the department to develop a strategic plan to address the existing station issues as well. Most of the stations were constructed at a time when fire apparatus was smaller and most of the stations were designed when the fire service was a male dominated profession. The emergency service community has changed over that period of time and it has been difficult for the stations to keep up with those changes.

As Tom Shand had mentions, fire apparatus is not getting any smaller, instead they are getting bigger. As the fire service changes to keep pace with the new challenges and demands, so to does the need for more equipment carried on these vehicles. Over the past few years their has been an increase in firefighter safety both on the vehicle and on the incident scene, these changes also have contributed to the increase in size of apparatus. However, this makes it challenging to departments that have older buildings when the stations were built, there was three or four feet of clearance when the apparatus was backed into the station.

Station restrictions are nothing new. This problem has been dealt with by many departments, especially older cities such as Baltimore, New York and Boston; all two bay

stations with 10 to 11 feet door clearances. They too have lowered station floors, built new stations or have worked with the manufactures to develop smaller apparatus.

Additionally, the department is discussing the possibility of increasing the staffing of the suppression units to 4 personnel, to be compliant with NFPA 1710. Increase staffing means that more space will be required to accommodate more personnel in the station. Presently, it would be difficult to increase the available sleeping space, without major renovation of inconvenience to its employees.

Presently, the city is looking at two major costly projects, a renovation and expansion of T.C. Williams Highs School, which is projected to cost about 100 million dollars and a new Police Headquarters; which could cost as much as 25 million dollars. Given those major projects it is even more apparent that the fire department needs to develop a strategic plan to address the station issue to bring to light these issues. It is interesting to note that the High School was built in 1972 and the last Police Headquarters was constructed in 1987.

Recommendation

The recommendation is a synthesis of the three questions combined to provide a single comprehensive approach instead of three individual solutions. It is recommended that the department develop a strategic plan to address costs and to develop a timeline to provide new facilities for the Alexandria Fire Department.

As a part of the strategic plan, the department needs to examine how to move Truck 204 and Rescue 206 to other stations in order to provide greater coverage to the city. As demands for EMS continue to increase, the city needs to incorporate an EMS unit into its design of newer stations.

As pointed out in the discussion, the department is looking at increasing its staffing to a minimum of four personnel. With additional personnel come additional space requirements for gear storage, locker space and sleeping facilities.

In the design for new stations, ample space must be provided for dining and food preparation, administrative work, exercise equipment, lounge, bunkrooms and bathroom facilities. The department needs to change from a station design of just two bays to a design of three or even four bays, taking into account the amount of property available either renovate or build on site. According to the U.S. Fire Administration manual on station designs, fire stations should be designed on a single level to deduce the risk of injury of personnel coming from upper floors.

It was noted during the five minute response mapping that there were several areas that had five minute response time overlap. This would suggest that there is some ability to relocate a station within a few blocks of the existing station, with little effect on the response averages.

The plan needs to be developed with specific data for each of the existing eight stations. Without getting into the availability of existing land, there are several alternatives that do exist; such as renovating existing buildings, relocating fire stations within existing communities and rebuilding new facilities on the existing property.

The existing facilities have served the Alexandria Fire Department well for many years; however, they have come to the point where they have exceeded their capabilities and equipment storage has been moved outside of the stations. With newer stations, the department will be able to redeploy some of its apparatus to insure a greater service capability while providing its employees with a safer and more ergonomic work environment.

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