APPARATUS REPLACEMENT GUIDELINE
FOR
CHESTERFIELD FIRE & EMS
EXECUTIVE LEADERSHIP

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ABSTRACT

Chesterfield County is a suburb of Richmond, Virginia with 265,000 customers in an area of 440 square miles. The fire and EMS department consists of 380 career and 150 volunteer firefighters who staff 17 first out engines, 9 second out engines, 5 truck companies, 7 full time ambulances, and 4 part time ambulances. Staffing levels are a minimum of three on the fire apparatus and two on the ambulances. Currently, Chesterfield County’s budget has a set amount for apparatus replacement. Unfortunately, there is not an Apparatus Replacement Guideline for Chesterfield Fire & EMS (CF&EMS) to follow when these funds become available to purchase new apparatus.

The problem is CF&EMS does not have an Apparatus Replacement Guideline to determine when apparatus should be rotated or replaced.

The purpose of this applied research project is to develop an Apparatus Replacement Guideline that will ensure the safe and efficient operation of the apparatus.

The action research methodology was used for this applied research project to answer four questions: (a) what, if any, are the national standards for replacement of apparatus?, (b) what, if any, are the state standards for replacement of apparatus?, (c) what are the apparatus replacement guidelines used by randomly selected departments in Virginia and throughout the nation?, and (d) what are the critical elements of an Apparatus Replacement Guideline for CF&EMS?

The results of this applied research project revealed an Apparatus Replacement
Guideline can be developed to ensure the safe and efficient operation of the apparatus.

It is the recommendation for this applied research project that CF&EMS implement an Apparatus Replacement Guideline to ensure the safe and efficient operation of the apparatus. This guideline shall address age, mileage, maintenance cost, and obsolescence. The budget will also be a part of the decision making process, but will not be specifically addressed in the guideline.
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INTRODUCTION

Chesterfield County is a suburb of Richmond, Virginia with 265,000 customers in an area of 440 square miles. The fire and EMS department consists of 380 career and 150 volunteer firefighters who staff 17 first out engines, 9 second out engines, 5 truck companies, 7 full time ambulances, and 4 part time ambulances. Staffing levels are a minimum of three on the fire apparatus and two on the ambulances. Currently, Chesterfield County’s budget has a set amount for apparatus replacement. Unfortunately, there is not an Apparatus Replacement Guideline for Chesterfield Fire & EMS (CF&EMS) to follow when these funds become available to purchase new apparatus.

The problem is CF&EMS does not have an Apparatus Replacement Guideline to determine when apparatus should be rotated or replaced.

The purpose of this applied research project is to develop an Apparatus Replacement Guideline that will ensure the safe and efficient operation of the apparatus for CF&EMS.

The action research methodology was used for this applied research project. The four research questions for this applied research project are:

1. What, if any, are the national standards for replacement of apparatus?
2. What, if any, are the state standards for replacement of apparatus?
3. What is the apparatus replacement guidelines used by randomly selected departments in Virginia and throughout the nation?
4. What are the critical elements of an Apparatus Replacement Guideline for CF&EMS?
BACKGROUND AND SIGNIFICANCE

Chesterfield County started purchasing fire apparatus for the various volunteer fire departments within the county that dates back to the 1950s. According to retired Battalion Chief D. Barfield (personal communications, February 27, 2002), the county would buy one piece of apparatus each year and would send it to a different station each year. Chief Barfield was a volunteer in the Bon Air Volunteer Fire Department from 1954 until he was hired as a career firefighter in 1967. Chief Barfield did not know if any organized rotation plan existed in those days. The rotation of the pumpers would come from the pumpers being in too poor of condition to keep them in-service. Chief Barfield believes the county started buying two pumpers a year and sometimes three a year starting in 1970. This was the standard practice until the budget constraints would not allow the purchase of 2 pumpers per year.

Battalion Chief D. Bowman (personal communications, February 28, 2002) was the Chief of Maintenance and Logistics from 1994 to 1998. Chief Bowman headed a committee that was responsible for developing an Apparatus Rotation Plan. The main focus of this plan was mileage and age. At that time, the County Administrator had an agreement with the committee for the apparatus to reach 100,000 miles by the age of 20 years. To accomplish this, Chief Bowman developed a plan based on these two criteria, which was to be reviewed annually. Before this plan could be completely implemented, Chief Bowman became an Operational Battalion Chief and turned the program over to Battalion Chief Lee Williams.

Unfortunately, this plan was never developed into a guideline. Battalion Chief L. Williams became the Maintenance and Logistics Chief in 1998 and was in that position
until July 2001. It became Chief Williams’ responsibility to develop a plan based on the current conditions of the pumpers (personal communications, February 26, 2002). He looked at the plan the committee came up with and added several items to it. According to Chief Williams the added maintenance cost, parts availability, and reliability of the apparatus became his focus. By adding these three categories, he elected to sell the newer Seagraves instead of the older Mack pumpers because of the upcoming rising cost of maintaining the Seagrave pumpers. Chief Williams was instrumental in getting the budget line item increased from $500,000.00 to $550,000.00. This increase would allow CF&EMS to buy two pumpers a year and rotate the other pumpers to second out or reserve. Chief Williams mentioned the increase in pumper cost was increasing faster than the allotted budget funds. If he bought pumpers that exceeded the allotted budgeted funds, then the additional funds would come from his budget. Towards the end of Chief Williams’ time in Maintenance and Logistics, he was unable to buy two pumpers a year and his apparatus replacement plan fell behind schedule. Also, no Apparatus Replacement Guideline was developed.

The author, S. Cooper, is the current Chief of Maintenance and Logistics and has been given the task of developing an Apparatus Replacement Guideline for CF&EMS. The budget reduction is one of the driving forces behind this assignment. The other driving force is the age of the pumpers. With the pumpers getting older (Appendix A) and the repairs increasing (Biennial budget, 2001), each pumper needs to be evaluated to make sure the right pumper is being replaced at the right time.

The impact of not having a program is causing additional work on the staff to figure out which pumper gets rotated, which one goes to second out, and which one
gets sold. This has been done on a monthly basis since July 2001. Also, the stations with older pumpers do not know when their pumper will be replaced and Lt. J. Flippin, Apparatus and Communications Coordinator, is concerned about how much money he should keep putting into these older pumpers to keep them running (personal communications, February 23, 2002). Lt. Flippin decides what and what does not get repaired. He also is a former 10-year salesperson for a fire apparatus manufacturer and has an extensive background in vehicle maintenance.

If a guideline is not developed and followed, the pumpers will get older and the cost of repair will increase. If this guideline is followed, the pumpers will be replaced systematically and hopefully, the repair cost will decrease due to having newer apparatus (Appendix A). This will benefit the department by having a safe and efficient operating pumpers to respond to the customers needs.

This applied research project meets the requirements established by the Executive Leadership Course at the National Fire Academy. It is the belief of CF&EMS that no program will be initiated that does not fall under the guidelines of the Strategic Business Plan. This belief is linked to Module 6, Succession/Replacement Planning of the Student Manual (2000). There are several specific links to the goals of the Strategic Planning Program (1998). The goals of the program are:

- To provide service that exceeds expectations
- To demonstrate sound fiscal management
- To integrate career and volunteer resources into a unified system
- To successfully manage change of the organization
LITERATURE REVIEW

The literature review for this research focused on four areas: (a) the national standards for replacement of apparatus; (b) the state standards for replacement of apparatus; (c) the apparatus replacement guidelines used by randomly selected departments in Virginia and throughout the nation; and (d) the critical elements of an Apparatus Replacement Guideline for CF&EMS? The first question was addressed by information in books. The second question was addressed by personal interviews and searching the Internet. Trade journal, newspaper article, and an Executive Fire Officer (EFO) Applied Research Project addressed the third question. Personal interviews, budget reports, and maintenance records addressed the fourth question.

The first question, “what, if any, are the national standards for replacement of apparatus?” was addressed by books with information on apparatus replacement. No national standard exist that specifically mandate when you must replace your apparatus. Cote (et al., 1997) recommends a pumper should be replaced, but that will vary from location to location. It is their belief the normal life expectancy for first-line pumpers is 10-15 years. Bachtler and Brennan (1995) share this belief and mentioned a couple of factors that will affect the life span of the pumper are how much the pumper is used and what type of maintenance programs the department follows. Peters (1994) believes another factor that can shorten the life span of a pumper is the type of calls the pumper responds to. If the pumper responds to brush fires, accidents, medical calls, and all structural calls, this will take a toll on the overall condition of the pumper. The National Fire Protection Agency (NFPA) does not recommend using first line pumpers over 25 years old (Peters, 1994).
The second question, “what, if any, are the state standards for replacement of apparatus?” was addressed by referencing books on the subject and conducting two personal interviews. No state standards were found in Virginia’s reference material on pumpers. This information was confirmed in a personal interview with Lt. Flippin, former fire apparatus salesperson in Virginia (personal communications, February 23, 2002). Dick Singer, Singer Associates, has been selling fire apparatus in Virginia for 36 years and said there is no standard that mandates when a pumper shall be replaced (personal communications, March 12, 2002).

A trade journal, newspaper article, and an EFO Applied Research Project addressed the third question, “what are the apparatus replacement guidelines used by randomly selected departments in Virginia and throughout the nation?”. Chattanooga Fire Department did not have a systematic approach for replacing fire apparatus. Over a period of time, their fleet became very old and in many cases obsolete. Chattanooga decided to conduct a management study on their fleet and hired an outside consultant to assist in correcting their problem (Crouch, 1997). Now, Chattanooga Fire Department uses several factors in which to replace their apparatus. The factors are: replace first out pumpers before they reach 20 years old, eliminate apparatus that has no operational usefulness, annually budget the necessary replacement funds, and develop a standard specification for the body and chassis.

An article written in The Washington Times newspaper (Keary, J., January 14, 2002) describes the condition of the District of Columbia (DC) Fire Department apparatus. Keary said, “D.C. firefighters are racing to fires in 15-year-old patched-up engines that should have been scrapped four years ago, according to Fire and
Emergency Medical Services documents” (p. A1). The article indicates this trend will only get worse in 2002. The “aging fleet” for D.C. Fire Department is first line pumpers over 7 years old used on a daily basis, and then the pumper is put into reserve status for 4 years.

In a trade journal, Connealy and Slagle (1999) representing Houston Fire Department were interviewed about their apparatus. Houston Fire Department was scrutinized by the television show “Dateline NBC” in 1998. Since that time, Houston has a new mayor, a new fire chief, and a new direction their department is going towards. Connealy and Slagle (1999) said, “before the reorganization, our Fleet Operations department had become the ‘masters of disasters’, jumping from one crisis to another” (p. 8). To correct the problem of an aging fleet and the maintenance issues, the Houston Fire Department has formed a committee to address the problem. To help offset the cost of the new pumpers, the old pumpers were traded in to lower the overall cost. Additional funds were obtained from Community Development Block Grants (CDBG) that would supplement the budgeted funds by the fire department. To assist in performing maintenance, a program was developed to help the firefighters operate the pumpers. To address the age of the fleet, a replacement program was developed. The goal of Houston fire Department is not to have first out pumpers over 12 years old.

Chief Senter, (1999) Norfolk Fire and Paramedical Services, addressed the issue of apparatus replacement in an EFO Applied Research Project. Senter suggests using a comprehensive data collection and management program to quantify data for analysis and for forecasting purposes. The data should include to total mileage, annual mileage, emergency responses, total engine hours, annual engine hours, annual maintenance
costs, annual maintenance cost per mile, and downtime for maintenance and repairs. Senter developed an Assessment of Operating Condition Survey with point values to assess apparatus. Senter (1999) believes this evaluation sheet allows the evaluator to remain subjective about a piece of apparatus.

The fourth question, “what are the critical elements of an Apparatus Replacement Guideline for CF&EMS?” was addressed by budget reports, maintenance records, and interviewing members of CF&EMS. Key members interviewed from CF&EMS list the “critical elements” of an apparatus replacement guideline as budget, maintenance cost, obsolescence, mileage, and age of the fleet.

The cost of the apparatus is increasing faster than the funds are increasing in the budget to cover the cost (Biennial Financial Plan, 2001). Retired Battalion Chief Barfield (personal communications, February 27, 2002) spent most of his career in support services. The plan from 1970 to present day was to buy two pumpers per year. Chief Barfield believes money was in the budget annually for apparatus replacement. If all of the money were not used, then it would “roll over” to the next year. According to Chief Bowman, Chief of M&L from 1994 to 1998, this same practice was in affect when he took over the division. Just before his transfer, the cost of two pumpers was higher than the allotted $500,000.00, the additional cost had to be absorbed from other parts of the budget (personal communications, February 28, 2002). Chief Williams, Chief of M&L from 1998 to 2001, was faced with the same budget shortfalls as Chief Bowman (personal communications, February 26, 2002). The author, S. Cooper, is the current Chief of M&L and is faced with a budget shortfall. The budget was cut in 2001 and 2002 resulting in only being able to purchase one pumper per year. Acting Deputy
Chief Hatton, Chief of Support Services, does not see any increase in the budget to offset these cuts. Alternative funding measures may have to be explored to assist in purchasing pumpers in the future (personal communications, March 4, 2002).

Maintenance cost, obsolescence, mileage, and the aging fleet is a major concern of M&L (Flippin, personal communications, February 23, 2002). The cost of repairing the apparatus is increasing each year. From 1995 to 2001, the maintenance cost has increased from $364,119.00 to $417,282.00 per year (Biennial Financial Plan, 1995 through 2001). Pumpers less than 10 years old cost $.66 to repair. Pumpers from 11 years old to 20 years old cost $1.08 to repair. Pumpers over 20 years old cost $1.22 to repair (Appendix A). With the increase in technology over the years, Lt. Flippin cited several pieces of apparatus as obsolete. The obsolete pumpers are over 20 years old, do not have headset communications in the cab, parts are not readily available, and the cabs are not completely enclosed (Peters, 1994). The miles put on pumpers throughout the county will accumulate differently from station to station. Pumpers that are used more frequently will reach 100,000 miles before they reach 20 years old (Appendix B&C). If these pumpers are not rotated, this will affect the life span of the unit (Peters, 1994).

Chief S. Elswick, Chief of Department, has instructed the M&L Division to have enclosed cabs for all first out pumpers, and then start on the second out pumpers (personal communications, August 13, 2001). Currently, there is no plan to address how to accomplish this task.

This literature review has provided the author, S. Cooper, with several common denominators to pursue further. These common denominators are the life span of first
out apparatus, maintenance cost, obsolescence, influencing factors, and funding for the replacement of apparatus (Appendix E). These denominators have influenced the author to develop a database for pumpers. This data will include age, overall maintenance cost, mileage, and cost per mile. Also, an evaluation sheet with point values need to be developed to evaluate the condition of the pumpers.

**PROCEDURES**

**Definition of Terms**

**Apparatus**- A self-propelled fire vehicle, including tank trucks, ladder trucks, pumpers, crash and rescue vehicles used to transport personnel and equipment to fires or other types of emergency calls. Kuvshinoff (1977)

**Executive Leadership**- For Chesterfield Fire & EMS this is the top leaders in the department. They are the fire chief, deputy chief of operations, deputy chief of support services, deputy chief of administrative services.

**FASTER**- Fleet Administrator Solutions and Transportation Equipment Report (FASTER) Is a proprietary software program that tracks vehicle repairs. (1982)

**National Fire Protection Associations**. A nonprofit educational and technical association, devoted to the protection of life and property from fire. Kuvshinoff (1977)

**Pumper**- A fire department pumping engine with a 500-gallon per minute pump or larger pump, hose, ladders, and equipment. Kuvshinoff (1977)

**Reserve Apparatus**- An Apparatus that is used when the first-line apparatus is in repair or put into service by off duty personnel on large incidents. Kuvshinoff (1977)

**RTA 1999**- Is proprietary software program that tracks maintenance cost, repairs, and vehicle history. Turley (1999)
Assumptions and Limitations

The assumptions made for this applied research project are on the data and the surveys. It is assumed the data collected from the Fleet Administrator Solutions and Transportation Equipment Report (FASTER) and RTA systems are accurate. The fire and EMS department depends solely on the County Fleet Maintenance Shop for data information they program in for repairs made on CF&EMS apparatus. The second assumption is the information collected from the surveys. It is assumed the information collected from the randomly selected departments is accurate.

There are two limitations on this applied research project. Due to time constraints, the data collected was gathered from an old system no longer used by Chesterfield Fleet Maintenance Shop. There is not enough time to quantify these numbers. Also, due to the time constraints, this project will only address pumpers.

Research Methodology

The action research methodology is used to answer four questions for this applied research project: (a) the national standards for replacement of apparatus, (b) the state standards for replacement of apparatus, (c) the apparatus replacement guidelines used by randomly selected departments in Virginia and throughout the nation, and (d) the critical elements of an Apparatus Replacement Guideline for CF&EMS? To answer these questions, information was gathered from a trade journal, a newspaper article, books, EFO paper, technical reports from Chesterfield County, and from personal interviews. The author used the guidelines in the student manual under the action research section (FEMA, 1998) on conducting surveys and personal interviews.
The focus of the surveys is to determine what other departments do for replacing their apparatus. These departments were randomly selected to give the author, S. Cooper, a broad perspective of what other departments are doing for apparatus replacement, regardless of the size of department. Questions were asked about budgeting and what factors their departments uses to base their decision (Appendix D).

The personal interviews were with key personnel in CF&EMS who gave information on the critical elements of an Apparatus Replacement Guideline. Also, interviews were conducted with personnel who have apparatus experience in CF&EMS.

**RESULTS**

**Research Question 1.** No national standards exist that specifically mandate when you must replace your apparatus. Cote (et al., 1997) recommends guidelines when a pumper should be replaced, but that will vary from location to location. It is their belief that normal life expectancy of first out pumpers is 10-15 years. Bachtler and Brennan (1995) also share this belief. The life span of the pumper will depend on how much the pumper is used and what type of maintenance program the department follows. Peters (1994) discusses another factor that affects the life span of a pumper, apparatus response. If the pumper responds to brush fires, accidents, medical calls, and all structural calls, this will take a toll on the overall condition of the pumper. According to Peters, the NFPA does not recommend using first out pumpers over 25 years old.

**Research Question 2.** Lt. Flippin is an Apparatus and Communications Coordinator for CF&EMS and a former salesperson for a fire apparatus manufacturer.
He stated there is no state standard mandating when apparatus must be replaced in Virginia (personal communications, February 23, 2002). This was confirmed by Dick Singer, Singer Associates, who has been selling fire trucks in Virginia for 36 years (personal communications, March 12, 2002).

**Research Question 3.** To see what other departments were using for apparatus replacement, the author, S. Cooper, identified reports, newspaper articles, EFO paper, and sent a survey to randomly selected departments.

Chattanooga Fire Department did not have a systematic approach for replacing fire apparatus. They decided to conduct a management study of their apparatus and hired an outside consultant to assist in correcting their problem (Crouch, 1997). Chattanooga Fire Department uses several factors in which to replace their apparatus. The factors are: age, operational usefulness, funds, and standardization.

An article written in *The Washington Times* newspaper (Keary, J., January 14, 2002) describes the condition of the District of Columbia (DC) Fire Department fleet. Keary says, “D.C. firefighters are racing to fires in 15-year-old patched-up engines that should have been scrapped four years ago, according to Fire and Emergency Medical Services documents” (p. A1). For D.C. Fire Department, first line pumpers over 7 years old should be replaced. After that, the pumper is put into reserve status for 4 years.

In a trade journal, Connealy and Slagle (1999) representing Houston Fire Department were interviewed about their apparatus. They said, “before the reorganization, our Fleet Operations department had become the ‘masters of disasters’, jumping from one crisis to another”(p.8). To correct the problem of an aging fleet and the maintenance issues, the Houston Fire Department formed a committee to address
the problem. To help offset the cost of the new pumpers, the old pumpers are traded in and CDBG Block Grants are used. To assist in performing maintenance, a program was developed to help the firefighters learn how to operate the pumper. To address the aging fleet, a replacement program was developed to have first out pumpers not over 12 years old.

Chief Senter (1999) of Norfolk Fire and Paramedical Services addressed the issue of apparatus replacement in an EFO Applied Research Project. Senter recommends a comprehensive data collection and management program to quantify data for analysis and for forecasting purposes. The data should include the total mileage, annual mileage, emergency responses, total engine hours, annual engine hours, annual maintenance costs, annual maintenance cost per mile, and downtime for maintenance and repairs. Senter developed an Assessment of Operating Condition Survey with point values to assess apparatus. This survey allows the evaluator to remain subjective when assessing apparatus.

A survey was sent to 50 randomly selected departments of all sizes to see what guidelines their department use for replacement (Appendix E). The size of the localities ranged from 5,000 to 3.3 million. The membership of the departments to serve these customers ranged from 27 to 3,000 (Appendix E). Of the 44 surveys that were returned, 34 have an Apparatus Replacement Program. For those departments that listed age, the average age for a first out pumper is 13 years. These departments use a combination of Lease, purchase, and lease/purchase programs to obtain apparatus.

**Research Question 4.** Key members interviewed from CF&EMS were asked to list the “critical elements” of an apparatus replacement guideline. They listed the
“critical elements” as budget, maintenance cost, obsolescence, mileage, and age of the pumpers.

The budget was cut in 2001 and 2002 leaving only enough money to purchase one pumper per year. Acting Deputy Chief Hatton, Chief of Support Services, does not see any increase in the budget to offset these cuts. The past practice of purchasing two pumpers a year will have to be reevaluated as well as alternative funding methods (personal communications, February 23, 2002).

Maintenance cost, obsolescence, mileage, and the aging fleet are a major concern of M&L, (Flippin, personal communications, February 23, 2002). The cost of repairing the apparatus is increasing each year. From 1995 to 2001, the maintenance cost has increased from $364,119.00 to $417,282.00 per year (Biennial Financial Plan, 1995 through 2001). As the pumpers get older, it cost more to repair them (Appendix A). To obtain this information, the author developed a database, then placed the information from FASTER and RTA into it (Appendix A). The old Information came from a software program called FASTER and it is not compatible with the new information from RTA. So the maintenance repair history is kept in two separate databases.

Pumper technology has increased over the years, causing several of CF&EMS pumpers to be considered “obsolete” (Peters, 1994). Lt. Flippin cited several pieces of apparatus that may be considered obsolete. These pumpers are over 25 years old, do not have headset communications in the cab, parts hard to obtain, and the cabs are not completely enclosed. It is the direction of Chief Elswick, chief of department, that all first out pumpers will have enclosed cabs, then the second out pumpers will have enclosed cabs (Elswick, personal communications, August 13, 2001).
The miles put on pumpers throughout the county are different from station to station. Pumpers that are used more frequently will reach 100,000 miles before they reach 20 years old (Appendix B&C). If these pumpers are not rotated, this will affect the life span of the unit (Peters, 1994).

Unexpected findings were the cost per mile data (Appendix A). The author expected the new pumpers to have a low cost per mile, approximately $.10 to $.15, then a “straight” line up for the older pumpers. Figure 1 shows the cost is $.49 for the newest pumper, then the prices varied up and down to the oldest pumper at $1.47.

![Cost per Mile Graph](image_url)

**Figure 1.** The cost per mile is listed from the newest pumper to the oldest pumper. The information in parenthesis is the age of the corresponding pumper number. Information was gathered from Appendix A.

Based on the findings of the Literary Review, an Apparatus Replacement Guideline (Appendix F) can be developed for CF&EMS to ensure the safe and efficient operation of the pumpers.
DISCUSSION

Evaluation of the information reveals information to develop an Apparatus Replacement Guideline for CF&EMS that will ensure the safe and efficient operation of the apparatus for its projected life span.

Regarding research question 1, No national standard exists that mandates when a first out pumper must be replaced. Several authors (Cote, Bachtler, Brennan, and Peters) gave recommendations on when pumper replacement and factors that affect their life span. Cote (et al., 1997) mentions the life span of pumpers will change from location to location. The normal life expectancy for first out pumpers is 10-15 years. Bachtler and Brennan (1995) believe two factors that can affect the life span are the usage of the pumper and the type of maintenance program the department follows. According to Peters (1994), one factor that will affect the life span of a pumper is the type of emergency calls the pumper responds to. If the pumper responds to brush fires, accidents, medical calls, and all structural calls, this will take a toll on the overall condition of the pumper. The age for replacing first out pumpers will vary from location to location, but the National Fire Protection Agency (NFPA) does not recommend using first out pumpers over 25 years old anywhere (Peters, 1994).

Regarding question 2, no state standards were found in Virginia’s reference material on pumpers. This information was confirmed in a personal interview with Flippin and Singer. Flippin is the Apparatus and Communications Coordinator for CF&EMS and sold fire trucks in Virginia for 10 years (personal communications, February 23, 2002). Dick Singer, Singer Associates, has been selling fire trucks in Virginia for 36 years (personal communications, March 12, 2002).
Research question 3 revealed limited funds and no organized replacement plan are the two common problems among most departments. CF&EMS is experiencing these same two problems.

Chattanooga Fire Department did not have a systematic approach for replacing fire apparatus and over a period of time, their apparatus became very old and in many cases obsolete. They decided to conduct a management study of their apparatus and hired an outside consultant to assist in correcting their problem (Crouch, 1997). Chattanooga Fire Department now has a guideline for when their pumpers will be replaced. Their guidelines are: replace first out pumpers before they reach 20 years old, eliminate apparatus that has no operational usefulness, annually budget the necessary replacement funds, and develop a standard specification for the body and the chassis.

An article written in The Washington Times newspaper (Keary, J., January 14, 2002) describes the condition of the District of Columbia (DC) Fire Department fleet. Keary says, “D.C. firefighters are racing to fires in 15-year-old patched-up engines that should have been scrapped four years ago, according to Fire and Emergency Medical Services documents” (p. A1). The lack of funds is being blamed for this aging fleet. DC Fire Department is an example of a department that uses a 7-year replacement because pumpers are being used on a daily basis. After this, Keary says the pumper is put into reserve status for 4 years.

Houston Fire Department was scrutinized by the television show “Dateline NBC” in 1998 for the condition of their apparatus. Since that time, Houston has a new mayor, a new fire chief, and a new direction their department is going towards. Connealy and
Slagle (1999) said, “before the reorganization, our Fleet Operations department had become the ‘masters of disasters’, jumping from one crisis to another” (p. 8). To correct the problem of an aging fleet and the maintenance issues, the Houston Fire Department formed a committee to address the problem. Their goal is not to have a first out pumper over 12 years old. Alternative funding methods were pursued to assist in purchasing these pumpers.

Chief Senter, (1999) Norfolk Fire and Paramedical Services, addressed the issue of apparatus replacement in an EFO Applied Research Project. Senter recommends a comprehensive data collection and management program to quantify data for analysis and for forecasting purposes. The data should include the total mileage, annual mileage, emergency responses, total engine hours, annual engine hours, annual maintenance costs, annual maintenance cost per mile, and downtime for maintenance and repairs. Using this information as a guideline, it was discovered during Literature Review that CF&EMS did not have access to all of this type of information. By using this data, CF&EMS can maximize the life span of the pumpers.

Regarding question 4, key members of CF&EMS were asked to list the “critical elements” of an apparatus replacement guideline. They listed the “critical elements” as budget, maintenance cost, obsolescence, mileage, and age of the fleet.

The plan from 1970 to present day was to buy two pumpers per year. Retired Battalion Chief Barfield (personal communications, February 27, 2002) alleged money was in the budget for apparatus replacement. Chief Bowman, Chief of M&L from 1994 to 1998, mentions this same practice was in affect when he took over the division. Just before his transfer, the cost of two pumpers was higher than the allotted $500,000.00
and the additional money had to be absorbed from other parts of the budget (personal communications, February 28, 2002). Chief Williams, Chief of M&L from 1998-2001, was faced with the same budget shortfalls as Chief Bowman (personal communications, February 26, 2002). The author, S. Cooper, is the current Chief of M&L and the budget shortfall is not getting any better. The budget was cut in 2001 and 2002 resulting in only being able to purchase one pumper per year. Acting Deputy Chief Hatton, Chief of Support Services, does not see any increase in the budget to offset these cuts. Alternative funding measures may have to be explored (personal communications, March 4, 2002).

Maintenance cost, obsolescence, mileage, and the aging fleet are a concern of M&L (Flippin, personal communications, February 23, 2002). The cost of repairing the apparatus is increasing each year. From 1995 to 2001, the maintenance cost has increased from $364,119.00 to $417,282.00 per year (Biennial Financial Plan, 1995 through 2001). The pumpers are getting older and are costing more to repair. Pumpers less than 10 years old cost $.66 to repair. Pumpers from 11 years old to 20 years old cost $1.08 to repair. Pumpers over 20 years old cost $1.22 to repair (Appendix A). These figures will provide a base line to assess apparatus in the future.

The miles put on pumpers throughout the county is different from station to station. Pumpers that are used more frequently will reach 100,000 miles before they reach 20 years old (Appendix B&C). If these pumpers are not rotated, this will affect the life span of the unit (Peters, 1994).

With the increase in technology over the years, Flippin cited several pieces of apparatus are obsolete (personal communications, February 23, 2002). The obsolete
pumpers are 20 years old and older, do not have headset communications in the cab, parts are not readily available, and the cabs are not completely enclosed (Peters, 1994). Chief Elswick, Chief of Department, has instructed the M&L Division to have enclosed cabs for all first out pumpers, and then start on the second out pumpers (personal communications, August 13, 2001). Currently, CF&EMS has 7 out of 26 pumpers over 20 years old and 10 do not have fully enclosed cabs (Appendix A).

The implications of this applied research project is for CF&EMS to implement an Apparatus Replacement Guideline. This guideline should address the issues faced by other departments; age, maintenance cost, mileage, and obsolescence.

RECOMMENDATIONS

It is the recommendation for this applied research project that CF&EMS implement an Apparatus Replacement Guideline (Appendix F) to ensure the safe and efficient operation of the pumpers. This guideline should be evaluated and updated on an annual basis.

The guideline shall address age, mileage, maintenance cost, and obsolescence. The budget will also be a part of the decision making process, but will not be specifically addressed in the guideline.

It shall be the goal of this guideline for first out pumpers to be no older than 15-17 years (Peters, 1994). These pumpers will then be rotated to second out or reserve status up to the age of 25-years (Cote, et al., 1997). Using the Apparatus Evaluation Sheet will assist the M&L in determining which pumpers are replaced or rotated and during which year (Appendix G). Since not all of the CF&EMS apparatus are the same, these moves should be kept to a minimum for safety reasons so the firefighters are not
operating a different type of apparatus every couple of years (Appendix A).

Mileage on each pumper will be a factor when determining when a pumper is rotated to second out or to a slower running fire company. Because the second out pumpers are getting older and do not have high mileage (Appendix C), only new pumpers will go to first out companies that are used on a daily basis. The Apparatus Evaluation Sheet (Appendix G) will assist in this decision. Currently, CF&EMS has 7 pumpers over 20 years old and only one of these pumpers has over 100,000 miles (Appendix B&C).

Maintenance cost should be evaluated annually. If the evaluation proves not to be economically feasible to keep fixing a pumper, the M&L will note this on the Apparatus Evaluation Sheet (Appendix G) and include this information in the replacement recommendations to the Executive Leadership.

Obsolescence should be tracked by the M&L Division and should be noted on the Apparatus Evaluation Sheet (Appendix G). When obsolescence is determined to be a factor, this information will be placed in the annual report.

A comprehensive data system is needed to have all cost to the vehicle in one data bank. Currently, pumper information is in four different locations. It is kept in two proprietary software programs, FASTER and RTA, at the County Maintenance Shop. The County Radio Shop keeps information on radio repairs for the apparatus and a vehicle tire vendor keeps the information on the apparatus tires. If all four of these data banks were in one place, a more accurate “cost per mile” data could be obtained and recorded on the Apparatus Evaluation Sheet.

The author’s recommendation to fire and EMS departments who do not have an
Apparatus Replacement Guideline is adopt a program that is currently being used by other departments. Research like-size departments to see what guidelines they are using and adapt this information to fit the needs of your department.
REFERENCES


http://earth.vol.com/~anderson/cfdweb/firestudy.htm


## Appendix A - Apparatus Operating Cost

<table>
<thead>
<tr>
<th>Vehicle #</th>
<th>Unit #</th>
<th>Model</th>
<th>Make</th>
<th>Mileage</th>
<th>Maint. Cost</th>
<th>Total Fuel</th>
<th>Insurance Cost</th>
<th>YTD Operating Cost</th>
<th>Cost P/Mile</th>
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<td>73</td>
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<td>PUMPER</td>
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<td>$18,678.73</td>
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</tbody>
</table>
Appendix B - Mileage Projection of First Out Pumpers

Current 15 Years 20 Years U53, 153, & U164 not enough data for projection
Appendix C - Mileage Projections on Second Out Pumper

[Bar chart showing mileage projections for different years and models, with columns for current, 20 years, and 25 years.]
Appendix D- Survey Request

EXECUTIVE FIRE OFFICER STUDENT
NATIONAL FIRE ACADEMY
EMMITSBURG, MARYLAND

TO:    Survey Participant

FROM:  Scott Cooper, Battalion Chief
        Chesterfield Fire & EMS

DATE:  February 10, 2002

SUBJECT:  Apparatus Replacement Guideline Survey

I am a 4th year Executive Fire Officer Student who is conducting a survey on Apparatus Replacement. As part of my research, I need information from you on what guideline your department has to replace apparatus.

Please take a few minutes and fill out the attached survey. I am asking you to return this to me by March 10, 2002. This survey can be returned by any of the three ways:

Fax: 804-751-9022

Email: scetmycoop@aol.com

Mail: Chesterfield Fire & EMS
      c/o Battalion Chief Scott Cooper
      PO Box 40
      Chesterfield, VA. 23832

Your information is extremely important to this project. If you would like a copy of the results, please indicate so.

Thank you for your time and assistance.
Appendix D con’t.- Survey Questions
EXECUTIVE FIRE OFFICER STUDENT
NATIONAL FIRE ACADEMY
EMMITSBURG, MARYLAND

1. What is the name and location of your department?

2. What is the size of your community (square miles)?

3. How many people live in your community?

4. How many fire/EMS personnel does your department have?
   Career __________  Volunteer __________

5. Do you have a guideline for replacing apparatus?

6. If yes, what are the major components you follow to replace apparatus?

7. If no, what criteria do you use to replace apparatus?

8. When you purchase apparatus, do you buy or lease?

9. Does your department budget allow you to buy on an as needed basis or is a certain amount of money budgeted each year for apparatus replacement?

10. When you take a piece of apparatus out-of-service, what do you do with it?

Thank you very much!
### Appendix E- Apparatus Replacement Survey Results

#### 0 to 50,000 population

<table>
<thead>
<tr>
<th>Name of Department</th>
<th>Size of Community Sq. Miles</th>
<th>Population</th>
<th># of Career FF</th>
<th>Number of Vol. FF</th>
<th>Replacement Program</th>
<th>Major Components of Program</th>
<th>Purchase Method</th>
<th>Hours in Bu.</th>
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<td>Rattlesnake FD.</td>
<td>66</td>
<td>5,000</td>
<td>0</td>
<td>40</td>
<td>No</td>
<td>N/A</td>
<td>Lease</td>
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<td>9</td>
<td>8,200</td>
<td>18</td>
<td>25</td>
<td>No</td>
<td>N/A</td>
<td>Purchase</td>
<td>N</td>
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<tr>
<td>Flossmoor FD</td>
<td>5</td>
<td>9,500</td>
<td>9</td>
<td>30</td>
<td>Yes</td>
<td>Age- 20 yrs.</td>
<td>Purchase</td>
<td>N</td>
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<tr>
<td>Palm Beach Fire</td>
<td>3.75</td>
<td>10,000</td>
<td>73</td>
<td>0</td>
<td>Yes</td>
<td>Age- 15 yrs.</td>
<td>Purchase/Lease</td>
<td>N</td>
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<tr>
<td>Lighthouse Point</td>
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<td>13,000</td>
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<td>0</td>
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<td>Age- 20 yrs.</td>
<td>Purchase</td>
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<td>Age- 12 yrs.</td>
<td>Purchase</td>
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# Appendix E con’t- Apparatus Replacement Survey Results

## 0 to 50,000 population

<table>
<thead>
<tr>
<th>Name of Department</th>
<th>Size of Community Sq. Miles</th>
<th>Population</th>
<th># of Career FF</th>
<th>Number of Vol. FF</th>
<th>Replacement Program</th>
<th>Major Components of Program</th>
<th>Purchase Method</th>
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<td>Sand Springs FD</td>
<td>75</td>
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<td>No</td>
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## Appendix E con’t- Apparatus Replacement Survey Results

### 51,000 to 150,000 population

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<th>Number of Vol. FF</th>
<th>Replacement Program</th>
<th>Major Components of Program</th>
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<th>Hours Between Purchases</th>
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<td>15.5</td>
<td>125,000</td>
<td>200</td>
<td>0</td>
<td>Yes</td>
<td>Age- 10 yrs.</td>
<td>Purchase</td>
<td></td>
</tr>
<tr>
<td>Hampton FD</td>
<td>56</td>
<td>146,437</td>
<td>238</td>
<td>150</td>
<td>Yes</td>
<td>Age, mileage, repair cost</td>
<td>Purchase</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix E con’t- Apparatus Replacement Survey Results

#### 151,000 to 2 million population

<table>
<thead>
<tr>
<th>Name of Department</th>
<th>Size of Community Sq. Miles</th>
<th>Population</th>
<th># of Career FF</th>
<th>Number of Vol. FF</th>
<th>Replacement Program</th>
<th>Major Components of Program</th>
<th>Purchase Method</th>
<th>How funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worcester FD</td>
<td>38</td>
<td>173,000</td>
<td>466</td>
<td>0</td>
<td>Yes</td>
<td>Age, condition</td>
<td>Purchase</td>
<td>No</td>
</tr>
<tr>
<td>Richmond FD, VA</td>
<td>62.5</td>
<td>198,000</td>
<td>414</td>
<td>0</td>
<td>Yes</td>
<td>Age- 12 yrs.</td>
<td>Lease</td>
<td>No</td>
</tr>
<tr>
<td>Lubbock FD</td>
<td>N/A</td>
<td>200,000</td>
<td>255</td>
<td>0</td>
<td>Yes</td>
<td>Age- 15 yrs.</td>
<td>Purchase</td>
<td>N/A</td>
</tr>
<tr>
<td>Providence FD</td>
<td>16</td>
<td>200,000</td>
<td>500</td>
<td>0</td>
<td>Unknown</td>
<td>Age, usage, condition</td>
<td>Purchase</td>
<td>N/A</td>
</tr>
<tr>
<td>Henrico FD</td>
<td>275</td>
<td>280,000</td>
<td>390</td>
<td>24</td>
<td>Yes</td>
<td>Age-12 yrs.</td>
<td>Purchase</td>
<td>No</td>
</tr>
<tr>
<td>Prince William FD</td>
<td>355</td>
<td>300,000</td>
<td>300</td>
<td>700</td>
<td>No</td>
<td>N/A</td>
<td>Purchase</td>
<td>N/A</td>
</tr>
<tr>
<td>W. Lanham Hills FD</td>
<td>128</td>
<td>300,000</td>
<td>600</td>
<td>1,800</td>
<td>No</td>
<td>N/A</td>
<td>Purchase</td>
<td>N/A</td>
</tr>
<tr>
<td>Minneapolis FD</td>
<td>55</td>
<td>370,000</td>
<td>483</td>
<td>0</td>
<td>Yes</td>
<td>Age- 5yrs.</td>
<td>Purchase</td>
<td>No</td>
</tr>
<tr>
<td>Omaha FD</td>
<td>117</td>
<td>600,000</td>
<td>605</td>
<td>0</td>
<td>Yes</td>
<td>Age, condition</td>
<td>Purchase</td>
<td>No</td>
</tr>
<tr>
<td>Memphis FD</td>
<td>600</td>
<td>900,000</td>
<td>1,600</td>
<td>0</td>
<td>Yes</td>
<td>N/A</td>
<td>Purchase</td>
<td>No</td>
</tr>
<tr>
<td>Fairfax FireRescue</td>
<td>399</td>
<td>950,000</td>
<td>1,200</td>
<td>200</td>
<td>Yes</td>
<td>Age, milage, repair cost</td>
<td>Purchase</td>
<td>No</td>
</tr>
<tr>
<td>Palm Beach FD</td>
<td>550</td>
<td>1 million</td>
<td>1,100</td>
<td>0</td>
<td>Yes</td>
<td>Age- 5 yrs., Mileage 72K</td>
<td>Purchase</td>
<td>N/A</td>
</tr>
<tr>
<td>Philadelphia FD</td>
<td>21</td>
<td>1.6 million</td>
<td>2,400</td>
<td>0</td>
<td>Yes</td>
<td>N/A</td>
<td>Purchase</td>
<td>Yes</td>
</tr>
<tr>
<td>Los Angeles FD</td>
<td>470</td>
<td>3.3 million</td>
<td>3,000</td>
<td>0</td>
<td>Yes</td>
<td>Age- 20 yrs.</td>
<td>Lease</td>
<td>No</td>
</tr>
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</table>
Appendix F - Apparatus Replacement Guideline

I. GENERAL

To ensure the safest and most efficient use of Chesterfield Fire & EMS (CF&EMS) resources, the following Apparatus Replacement Guideline shall be the standard practice until further notice. The goal of this guideline is to have first out pumpers replaced between 15-17 years old, second out pumpers replaced between 20-22 years old, and reserve pumpers replaced before 25 years old. Factors influencing apparatus rotation are: age, budget, mileage, cost per mile, and overall condition of the unit.

The chief of department, with input from the chief of operations and support services, will publish the Apparatus Replacement Plan annually.

II. PROCEDURES:

1. First out Pumpers shall rotate to second out status between 15-17 years old.

2. Once a first out pumper reaches between 80,000 to 90,000 miles, it will be rotated to a slower running company.

3. As resources permit, all first line pumpers will have fully enclosed cabs, then second out pumpers.

4. During the annual station budget inspections, apparatus will be inspected using the Apparatus Evaluation Sheet.

5. Scores from the Apparatus Evaluation Sheet will be compiled by the Maintenance & Logistics Division and summarized in a report.

6. A report will be given to the Executive Leadership with recommendations on which apparatus should be replaced and/or rotated for that year.

This list will change annually depending on the needs of the department.
Appendix G- Apparatus Evaluation Sheet

Unit # _____ Vehicle # _______ Year ________ Make __________ Model __________
Beginning Mileage _______ Ending Mileage _______ Total Miles Traveled _______

1. **Cab Assembly** (includes metal skin, structural components, steps, doors, windows, paint, and upholstery):
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5

2. **Body Assembly** (includes metal skin, structural components, compartments, doors, shelves, and trays):
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5

3. **Drive Train** (includes engine and, transmission)
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5

4. **Suspension** (includes struts, shocks, leaf springs, and insta-chains)
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5

5. **Fire Pump**
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5

6. **Booster Tank**
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5

7. **Foam System** (if applicable)
   - **Excellent** 1
   - **Very Good** 2
   - **Good** 3
   - **Fair** 4
   - **Poor** 5
8. **Electrical System**

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

9. **Mileage-** ("K"= 1,000)

<table>
<thead>
<tr>
<th></th>
<th>0-25K</th>
<th>26K-50K</th>
<th>51K-75K</th>
<th>76K-100K</th>
<th>00K+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

10. **Cost per mile**

<table>
<thead>
<tr>
<th></th>
<th>0-$.25</th>
<th>$.26-.50</th>
<th>$.51-$1.00</th>
<th>$.76-$1.00</th>
<th>$1.00+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

11. **Age-** (years old)

<table>
<thead>
<tr>
<th></th>
<th>0-5</th>
<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
<th>20+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

12. **Overall Appearance**

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

**Overall Score:** _________________