Development of a policy for the use of Class A foam for the Greensboro Fire Department

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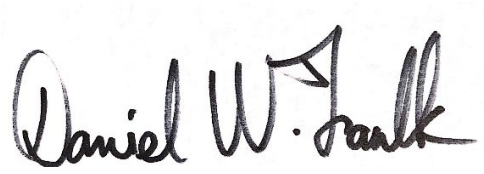
Signed: 

Abstract

The problem was that although foam systems are installed on the Engines of the Greensboro Fire Department (GFD), the suppression companies were not utilizing Class A foam to the fullest extent. This applied research project's purpose was to develop a policy or a General Operating Guideline (GOG) on Class A foam use that included the importance and understanding of its use and a training regimen for line companies. The action research method was used to create a GOG that did not exist. This research was completed with the following research questions: (a) Why are GFD companies not using Class A foam from their onboard foam systems?, (b) What training is needed on the use of Class A foam and the apparatus' foam systems?, (c) How are other departments utilizing Class A foam in their current firefighting operations?, and (d) What policies regarding Class A foam are present and in use within other departments? A literature review was conducted to gain information on Class A foam and policy development. Data was collected on the GFD suppression fleet, and information was gained regarding foam supply and distribution within the department. Questionnaires were administered to 87 company officers and 96 engineers of the GFD. Another questionnaire was sent to 54 representatives of outside fire organizations. The results revealed that Class A foam was not regularly used within the GFD, training on foam systems was lacking, and the desire for further training was present. Outside organizations that use Class A foam indicated a majority do not have policies, but importance is placed proportioner competence. A policy was developed and recommended to stress advantages of Class A foam, to implement a guideline for Class A foam usage, and to set a training plan for Class A foam use and onboard foam proportioning systems.

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Introduction

The Greensboro Fire Department (GFD) is an Insurance Services Office (ISO) class one fire department that is also internationally accredited by the Commission on Fire Accreditation International (CFAI) (ISO Rating & Accreditation, n.d.). Most engine companies within the GFD have on-board foam systems with the ability to flow foam from every discharge port. The problem is that although foam systems and foam supply tanks are installed on the GFD's engines, the suppression companies are not utilizing their Class A foam systems to the fullest extent.

The purpose of this Applied Research Project (ARP) is to develop a General Operating Guideline (GOG) for using Class A foam. This will include providing a training outline for the importance and understanding of its use. The goal of this research is to provide a GOG that educates for better knowledge on the advantages of Class A foam use, ensuring full fire extinguishment while also providing firefighter safety and preventing rekindles of structure fires.

The action research method was used for this ARP to develop the much-needed GOG that did not previously exist. Data was collected on the GFD's fire suppression fleet as well as the department's foam supply and distribution methods. Conversations were held with involved persons and questionnaires were distributed to answer the following research questions: (a) Why are GFD companies not using Class A foam from their on-board foam systems?, (b) What training is needed on the use of Class A foam and the apparatus' foam systems?, (c) How are other departments utilizing Class A foam in their current firefighting operations?, and (d) What policies regarding Class A foam are present and in use within other departments?

Background and Significance

Greensboro, North Carolina is the county seat of Guilford County, located near the center of the state in the region popularly known as the Piedmont. The population of Greensboro in 2017 was 290,222 making it the third largest North Carolina city by population (United States Census Bureau, n.d.). The city covers 132.9 square miles and is protected by the 25 fire stations of the Greensboro Fire Department (GFD) (Department Operations, Greensboro, NC, n.d.).

The GFD operates to provide fire protection, hazardous materials response, rescue, and emergency medical care to all citizens of Greensboro. Becoming a fully paid organization in 1926, the department currently employs 584 paid fire fighters making up the line suppression companies, training and administrative positions, as well as the inspectors and investigators of the Fire & Life Safety Division. The city is now divided into 5 battalions, each containing 5 fire stations and supervised by one Battalion Chief per shift. At this writing, a twenty-sixth station is under construction on the east side of the city. There are two hazardous materials teams, one heavy rescue unit, and an urban search and rescue team (USAR) that specializes in structural collapse, rope rescue, and water rescue. The GFD also maintains a foam task force and a trail response/bike team as part of its Special Operations Division (Department Operations, Greensboro, NC, n.d.).

The GFD maintains twenty-four engine companies and eleven ladder trucks. All engine companies except one have foam systems with the necessary on-board foam tanks. All ladder trucks have pumps and accompanying water tanks, yet only 2 have foam systems. Through the last twenty years the department has managed to maintain an excellent fleet of pumpers with a regular replacement schedule, purchasing new trucks almost every year since the early 2000's. In recent years, as new fire engines have been purchased, the GFD has ensured the apparatus are

built to include firefighting foam tanks and foam induction systems. The most recent engine purchases have been outfitted with proportioners manufactured by Williams Fire and Hazard Control. Able to flow Class A or Class B foams, these devices introduce foam to the fire streams by inducting foam with an "around the pump" feature that is water driven, meaning there is no foam pump. Williams' system is appropriately named the "Williams Around-The-Pump" (WATP) device. The newer GFD trucks have both Class A and Class B foam tanks, as the WATP can convert either foam concentrate to a foam solution. Foam concentrate can also be proportioned from a separate supply by drawing through an auxiliary foam inlet (Williams Fire & Hazard Control, 2018)

Although the fire engines of the GFD currently have foam capabilities, the systems are not used on a regular basis at structure fire events. The use of foam is tracked by the GFD's Foam Task Force headquartered at Fire Station 19 where foam supplies are currently stored. As units use foam from their tanks through their foam systems, they contact Station 19 personnel to get the supply replaced in the tanks. Engine 19 Engineer Vince Atkins revealed that through the records kept by Station 19, fire companies are not refilling Class A foam tanks following most structure fires, indicating they are not using their foam systems and Class A foam to the fullest potential (V. Atkins, personal communication, September 29, 2018).

There is a General Operating Guideline (GOG) for foam emergencies, however this policy is geared toward flammable liquid fires and the Class B foam supplies and equipment maintained and used by the GFD's Foam Task Force. There is no policy containing information on the use of Class A foam. There has been training on Class B foam products and there are periodic training evolutions for the companies that make up the foam task force regarding flammable liquid fires, yet no departmentwide training for Class A foam. This research project

will develop just such a GOG that indicates the need for Class A foam use and when/where to use it. This ARP will also recommend a training schedule to maintain proficiencies with the foam systems and the knowledge base of Class A foam use.

This project is significant to the GFD and the City of Greensboro because large amounts of money have been spent outfitting the apparatus with foam proportioning systems and the accompanying foam tanks, not forgetting the cost of the actual foam product and supply itself. Tommy Millikan is the supervisor for the GFD garage and is heavily involved in the apparatus specification process. When asked about the costs that are added to an apparatus purchase order, Mr. Millikan stated that outfitting a new engine with a foam system and the necessary tanks costs approximately $15,000 per apparatus. Considering the number of GFD engines with foam systems, a sizable amount of money has been budgeted to ensure companies have foam capabilities (T. Millikan, personal communication, January 7, 2019)

The purpose of this ARP is to find out why Class A foam is not used within the GFD to its full potential and to create a GOG on its use and training. Additionally, this project will point out the advantages of using Class A foam while also encouraging its application during structure fire events. This is important because there are still occasional occurrences of structures rekindling after a fire was thought to be extinguished, thus causing fire companies to redeploy to the same address. There is also the issue of fire fighter safety and how exposures to carcinogens may be reduced with the use of Class A foam.

This project is in line with the Executive Fire Officer Program (EFOP) and the third-year course Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM) delivered at the National Fire Academy in Emmitsburg, Maryland. This project relates specifically to the course by addressing portions of the curriculum's goal of providing the

"knowledge and skills needed to effectively analyze emergency operations" (EAFSOEM, 2016, p. vii).

This project also meets two of the United States Fire Administration's Strategic Goals. The first relative goal is Goal 2: "Promote response, local planning and preparedness for all hazards" because this project aims to improve the GFD's ability to prepare for, respond to, and mitigate fire incidents. The next is Goal 3: "Enhance the fire and emergency services 'capability for response to and recovery from all hazards" because this project will improve education and training within the GFD (United States Fire Administration [USFA], 2013, p. 11-12).

Literature Review

The literature review for this ARP began in Emmitsburg, Maryland at the National Fire Academy's Learning Resource Center (LRC). The locations of trade journals, periodicals, and books related to Class A foam were discovered plus relevant ARP's from current and former EFOP candidates were found. Some printed materials regarding Class A foam also contain information on compressed air foam systems (CAFS); however, this review concentrated on the Class A foam product itself and its use, not the proportioning device.

To begin this research project, an understanding of what foam is and why it is vital for firefighting must be presented. The National Fire Protection Association (NFPA) defines foam in the standard NFPA 11 as "a stable aggregation of bubbles of lower density than oil or water" (National Fire Protection Association [NFPA], 2016, p. 11-8). An additional definition is provided in NFPA 1450 by describing foam as "the aerated solution created by forcing or entraining air into a foam solution by means of suitably designed equipment or by cascading it

through the air at a high velocity" (National Fire Protection Association [NFPA], 2017, p. 1145-6).

Class A foam was first developed in the 1980's and was initially used primarily for fighting and extinguishing wildland fires. Its use then progressed to fighting structure fires during the 1990's. Named for the Class A fuels of ordinary combustible materials such as wood, paper, and cloth fabric, the Class A foam adds to the water's cooling ability by helping the water penetrate the burning material for better extinguishment, especially the deep-seated smoldering fire that may be present (Hubert, 2015).

According to Keith Klassen, Class A foam is a "high-grade synthetic detergent". It is an ingredient added to water that reduces the surface tension of the water, making it spread out creating more surface area and thereby improving heat absorption. Less tension causes the water to penetrate tighter spaces within the Class A fuels, providing better protection from heat and direct flame impingement due to the rise in the fuel's moisture level (Klassen, 2010, p. 105).

The NFPA also has its own definition of Class A foam that is found in the standard NFPA 1150, the Standard on Foam Chemicals for Fires in Class A Fuels. Here the finished foam is described as the foam used for fires in Class A fuels such as "vegetation, wood, cloth, paper, rubber, and some plastics in which combustion can occur at or below the surface of the material" (National Fire Protection Association [NFPA], 2017, p. 1150-5).

A more detailed and comprehensive definition of Class A foam is found in "Annex A – Explanatory Materials" of NFPA 1145, the Guide for the Use of Class A Foams in Fire Fighting:

> Class A Foam. The foam bubbles and the solution draining from them attach to and penetrate Class A Fuels due to the reduced surface tension imparted to the water by the foam concentrate. The bubbles hold moisture and release it as the foam breaks down,

> prolonging the time the moisture can be absorbed by the fuels. When applied in adequate quantities, the foam acts to exclude air from the fuel-air interface, envelope combustible vapors, and resist disruption due to wind, heat, and flame. (National Fire Protection Association [NFPA], 2017, p. 1145-14).

Class A foam products are "oleophilic" meaning oil-loving while also being "hydrophilic," or water-loving. This means the foam concentrate is drawn to the water as well as to the oils of Class A fuels, pulling the moisture into the fuel. Class A foam is, of course, a "bubble producer" that allows the moisture to penetrate into the burning matter and surrounding unburnt materials (Colletti, 2006, p. 29).

Colletti continues and describes two distinct benefits of Class A foam in his text. The first benefit is the rapid absorption of heat from burning fire gasses. The second benefit of a Class A foam blanket is that it keeps moisture in direct contact with not only the horizontal matter but also the vertical fuels. Class A foam will adhere to vertical surfaces better than water, keeping the material cooler and wetter. Water will just roll down on a vertical surface such as a wall, and not penetrate well, if at all (Colletti, 2006, p. 30).

In Colletti's text *Class A Foam – The Best Practice for Structure Firefighters* he describes how the surface tension of water is reduced with the use of a Class A foam additive. He writes that surface tension will limit water from absorbing heat. Alone, water will "bead", allowing only a certain amount of heat absorption through the one spot of contact. Add a foam concentrate to the water and the water's density is lessened, causing the water to now make contact with the fuel over a wider surface area. This action will permit better heat transfer at the contact points that will occur faster compared to just a water application (Colletti, 1998).

Hubert writes in another article the use of foam in general is not understood and at times confusing. City fire departments have not widely accepted the use of Class A foam mainly because of the fear of its cost. He adds that using Class A foam may actually save a department money by allowing a fire to be extinguished faster and with less water. Class A foam essentially increases firefighting potential by "making water wetter", reducing overhaul time and post-extinguishment work, allowing companies to return to service sooner (Hubert, 2014, p. 40).

The technology of Class A foam has been around for several decades now, but Klassen, who is a well-known advocate for foam use, states many organizations in the fire service still have not fully adopted it. He writes this is due to two key reasons: "lack of proper foam education and training; and inaccurate information about foam that has circulated through the fire service" (Klassen, 2012, p. 22).

Class A foam is an enhancement to firefighting water, not a replacement. Knowing this, fire fighters should maintain initial attack flow rates and not reduce gallons per minute (GPM) just because foam concentrate is added to the water. Having done work for Task Force Tips (TFT), Rod Carringer writes that only a 0.1% to 0.2% addition of Class A foam concentrate to a fire stream "provides amazing knockdown performance by simply reducing the surface tension of the water" (Carringer, 2015, p. 24).

Colletti is a known proponent of Class A foam and has detailed why water alone has disadvantages in firefighting today. One disadvantage that has been described elsewhere is water's tendency to drain off vertical surfaces and horizontal surfaces as well. Another disadvantage is the actual weight of the water itself. He states that 250 GPM is equal to 1 ton/minute, adding weight that can cause a structure to collapse during a firefighting operation (Colletti, 1998).

Janet Wilmoth was the editorial director of *Fire Chief* and coauthored several supplements to the magazine on the benefits of Class A foam. In one particular entry she stressed how the use of Class A foam increases firefighter safety while also reducing environmental impact. This is due to the Class A foam's ability to attract and adhere to carcinogenic hydrocarbon gases such as benzene. The foam stops some of the smoke and prevents cancer-causing molecules from being released causing further exposure (Wilmoth, 2012).

This was not the first time Wilmoth related the use of Class A foam to improved firefighter health. She previously wrote that firefighters' lives will be saved by using Class A foam. She listed the ways: "less interior exposure, quicker knockdown, less stress and fatigue, and less time on the scene" (Wilmoth, 2011, p. 3).

Additional literature was discovered on Class A foam use and its correlations to firefighter health. Gary Baum, an EFOP candidate from Amboy, Illinois completed an ARP in which tests with Class A foam products were conducted to find out if carbon-based carcinogens from a structure fire were reduced through the use of Class A foam. Eleven live-fire tests with the same fuel loads were held and measurements of carbon monoxide, hydrogen cyanide, benzene 15a, benzene 25a, chloroform, formaldehyde, styrene phenol, and styrene ethyl benzene were taken. The results of the testing revealed that levels of benzene 15a, benzene 25a, and formaldehyde were reduced with the use of Class A foam compared to firefighting with water only. These reductions due to foam can indeed reduce fire personnel's exposure to carcinogens at structure fire operations (Baum, 2016).

Fire personnel and pump operators must be familiar with the use of foam for firefighting operations. They must understand its purpose and know when and where to apply it. Jeff Cotner

in *Fire Engineering* wrote that fire personnel must know how to operate their respective foam systems and be able to confidently perform a foam application operation. Foam calculations must be understood, just like pump pressures, to get the necessary ratio for the task at hand. Cotner additionally mentions studies on Class A foam from the 1990's that confirmed Class A foam use can greatly improve a company's firefighting effectiveness and personnel safety (Cotner, 2007).

John Liebson wrote about the need for departmental policies when adopting Class A foam. In his piece for the *American Fire Journal* he states "the adoption of Class A foam as part of the standard firefighting practices of a structural fire department requires the concurrent adoption of new policies" (Liebson, 1996, p. 6). Providing a policy on Class A foam will assist with training and ensure personnel will learn and understand why and how this foam product can work. Liebson continues with saying that Class A foam is an "agent of change" requiring "modern management techniques" that must replace the old way of doing things. (Liebson, 1996, p. 8).

Sean Carter Mitchell's thesis for his Master of Science degrees in Fire Protection Engineering presented to the faculty of California Polytechnic State University looked at Class A compressed air foam systems compared to water only firefighting. The research was done to evaluate the use of Class A foam products (and CAFS) and their ability to reduce the temperatures during interior firefighting, based on the advantages of Class A foam over water. Mitchell listed the "claimed advantages" in his study as:

- Class A foam is faster than plain water in fire suppression and extinguishment
- Class A foam uses water efficiently and conservatively
- Class A foam concentrate is relatively inexpensive

- Class A foam creates a protective blanket
- The foam is clearly discernable during and after application
- The foam adheres to most surfaces and is retained much longer than plain water
- CAFS hoselines are much lighter than water hoselines
- The foam may increase preservation of fire forensic evidence
- Class A foam supports wildland/urban interface attack
- Class A foam may provide long term financial savings and less severe property damage
- The foam may help reduce stress and fatigue on firefighters
- Class A foam enhances the cooling ability of water (Mitchell, 2013, p. 6-7).

Mitchell reviewed past live fire simulations in acquired structures as well as "constructed mock-up structures". This review included the results of five mock-up structures and seven acquired structures. In his summary of these prior tests, Mitchell found that foam use was "at least equal to if not more effective than water at suppressing fire in a structure" (Mitchell, 2013, p. 32).

In live fire tests, Mitchell measured the cooling effects of plain water versus Class A foam application with temperature measurements which took place at different heights in the burning structures. Some areas were found to be cooled better by water only, while other areas seem to be better cooled by foam. In his discussion, Mitchell wrote the "results from the temperature data of the gas cooling experiments are inconclusive" (Mitchell, 2013, p. 60). He therefore noted limitations and recommended a re-examination of the data and further research on the cooling differences between water and Class A foam.

This project's literature review then turned to a search for information on policy development. It is universally understood that policies and procedures are important not just for the fire service, but for any organization. Policies can provide an organized and safe workplace, protecting employees. Susan Heathfield presents situations in which a new policy should be considered. One instance is when there is misunderstanding on a particular subject. Another situation may be to set forth consistent standards and/or rules (Heathfield, 2018). These situations can be seen regarding the use of Class A foam products for firefighting.

Writing for *Police Magazine*, Amaury Murgado, a retired special operations lieutenant from the Osceola County, Florida Sheriff's Office, described how to create a policy for law enforcement organizations. The method presented here is a plan that has worked for his community and can also be of use for the fire service. His article outlines his favored process:

1. Identify and define the problem
2. Identify purpose
3. Identify who will take lead responsibility
4. Gather information and conduct research
5. Draft policy to define what and procedures to define how
6. Consult with subject matter experts
7. Finalize and approve policy
8. Implement
9. Communicate
10. Monitor, review, and revise (Murgado, 2018).

Murgado adds that the development of a review team or committee will be most helpful in the last step. From the law enforcement view, he also recommends the addition of a legal review from an attorney (2018).

The Environmental Protection Agency (EPA) has developed its own document for creating a policy or a standard operating procedure (SOP). The term SOP can be viewed as interchangeable with a GOG. In this paper designed for a federal entity, it is stated in the introduction that "the development and use of SOPs are an integral part of a successful quality system as it provides individuals with the information to perform a job properly, and facilitates consistency in the quality and integrity of a product or end-result" (Environmental Protection Agency [EPA], 2007, p. 1).

The EPA's formal document is very detailed and includes samples to assist those within the agency who may be developing a new policy. Although it is published by and designed for a government organization, it can be very helpful for anyone wanting to create a new policy for their various workplace. Presented in this guide it is stated "SOPs should be written with sufficient detail so that someone with limited experience with or knowledge of the procedure, but with a basic understanding, can successfully reproduce the procedure when unsupervised" (EPA, 2007, p. 3). This will be a very helpful document for anyone using action research to develop a new policy for their department.

The EPA further recommends a newly written policy should be reviewed by personnel experienced with the particular field or process before it is put into place. After implementation, the policy should always be current and should therefore be reviewed on a regular basis, such as every 1-2 years to ensure the procedures are still appropriate. Updates and/or changes, if needed, can be done at these periodic reviews (EPA, 2007).

One last piece of literature was perused to gather further information on policy development. This document from the Society for Human Resource Management (SHRM) provides five steps to aid in creating a policy. The steps presented here are similar to the steps seen in other literature, but should also be considered. The first step is to identify the need for a policy. The next step will be to determine the policy content, such as with rules and procedures, ensure the terminology is correct, fair, and not too rigid (Society for Human Resource Management [SHRM], 2018).

The third step according to SHRM is to gain the support of the stakeholders. This means to communicate the drafted plan with managers and supervisors via meetings, emails, etc. as to why it is being put into place and what the expectations should be. The fourth step is to communicate the plan to the actual employees and introduce the policy. This step should allow those affected the opportunity to ask questions and/or provide input. The fifth and last step is to of course update the policy and revise as necessary, at least once a year per this article (SHRM, 2018).

Procedures

This project's purpose was to create and develop a GOG on the use of Class A foam within the GFD. To assist with this development, this ARP's research questions were: (a) Why are GFD companies not using Class A foam from their onboard foam systems?, (b) What training is needed on the use of Class A foam and the apparatus' foam systems?, (c) How are other departments utilizing Class A foam in their current firefighting operations?, and (d) What policies regarding Class A foam are present and in use within other departments?

The first procedure for this ARP was the collection of data on the GFD engine and ladder company fleet. This gathering of information was done by communicating directly with veteran

GFD Engineer Vince Atkins from Station 19 by personal conversations and telephone calls during the summer and fall of 2018. Atkins has kept records for the GFD Foam Task Force for well over a decade, including keeping GFD apparatus data, such as which units maintain foam systems and the respective foam supply tanks. Additional information on apparatus specifications was gathered by visiting various stations and visually verifying the set-up of some engine companies. Phone calls were placed and conversations were held with select Engineers as needed to verify specific information pertaining to individual differences between systems.

Three questionnaires were designed and administered using the online tools available through the internet website Survey Monkey (www.surveymonkey.com). The questionnaires were all purposefully set with an end time of three weeks, at which time the program would close internet access to the questionnaires.

The first questionnaire was developed for the 72 Captains of the GFD engine companies as well as the 15 roving Lieutenants who fill in during Captains' absences. These 87 individuals received a link to the Surveymonkey.com website via email and were asked questions regarding their history of using (or not using) Class A foam at a fire event. This questionnaire also asked questions about past and future training on Class A foam to determine future training needs. See Appendix A for a copy of the email message directing these Captains and Lieutenants to the online questionnaire. Of the 87 company officers asked to do the questionnaire, only 31 individuals responded to the request. This presents a limitation to this process by showing that only 35.63 % of the intended audience actually opened and completed the questionnaire. Another limitation noted with this questionnaire was observed by noting the number of questions that were skipped by certain anonymous respondents. See Appendix B for the questions and full results of this particular questionnaire detailed by Surveymonkey.com.

The next questionnaire was also linked to the Surveymonkey.com website and was directed toward the 96 current Engineers within the GFD. Appendix C presents the email sent to these individuals asking for their participation with the questionnaire. This sample included the Engineers of the ladder companies as well as the engine companies because all engineers go through the same promotional process and participate in the same periodic training, regardless of apparatus assignment. Some ladder engineers may have also served previously on engine companies. All apparatus driver/operators were asked questions regarding past training on Class A foam and if they would like future opportunities to participate in foam training.

Of the 96 individuals currently assigned to drive and operate the fire trucks of the GFD, 53 responded by completing the request to assist the research. This questionnaire resulted in a 55.20% return and presented no obvious limitations. See Appendix D for the questions asked of the engineers and the results as posted by Surveymonkey.com.

The third questionnaire was also delivered by email by two different messages containing the same link to the Surveymonkey.com site processing the questionnaire. These two samples combined included 54 persons from various fire organizations in North Carolina and across the United States. Appendix E shows the email message sent to the department representatives from North Carolina. Appendix F contains the message to fire service members from elsewhere in the United States. The North Carolina samples were selected from fire departments associated with the Professional Fire Fighters and Paramedics of North Carolina. The organizations represented here were selected to gain a diverse sampling of departments of various sizes. The representatives from other parts of the United States were sampled from a recent class roster from the NFA's EFO Program, also portraying a wide range of department sizes and organizational make-ups. Appendix G lists the organizations/municipalities represented in this

sample. This questionnaire asked about the individuals' use of Class A foam and whether or not their department had a usage or training policy for such. See Appendix H for the questions posed to these individuals as well as the accompanying results as detailed by the Surveymonkey.com website tool.

One last procedure was the email correspondence with Battalion Chief Brett Combs, one of the Chief Officers assigned to the GFD Training Division. This conversation included the inquiry into whether or not the members of the GFD recruit classes were trained on the use Class A foam. Chief Combs provided the training outline used to instruct the recruits, which is a small portion of the section used to instruct hose and fire streams. This outline is basic, of course, and presents mainly Class B foam guidelines and foam eductor calculations. There is very little information on Class A foam, however there is mention of the Class A foam product currently in use by the GFD. Refer to Appendix I for Chief Combs' email and the accompanying excerpt he provided from the recruit training outline.

Results

The collection of GFD apparatus data was done to show how the department has emphasized the installation of foam proportioning systems during the last fifteen years. Of the twenty-four front line engine companies, all have foam systems but one. This particular engine without a foam proportioning system is, in fact, the oldest truck in the GFD fleet. Two of the twenty-four companies are stationed adjacent to the Colonial and Plantation Pipelines where dozens of above ground petroleum tanks are present. These two apparatus, Engine 19 and Engine 20, have foam systems with only a Class B foam supply intended for flammable liquids.

It is the oldest engine company in the fleet, a 2003 model American-LaFrance, that does not have a foam system. Every engine purchased since then has a foam system incorporated

with the pump. Four engines were manufactured by Pierce with the three oldest operating with the Foam Pro brand of foam system and Class A supply tanks. All other apparatus are Sutphen engines with the Williams' WATP configuration, except a 2018 Pierce pumper. These engines are outfitted with both Class A and Class B foam tanks. Table 1 below lists the current frontline engine company fleet along with details on foam system type and onboard foam supply tanks.

Table 1

Engine companies of the GFD with foam system and supply data 2018

	Company	Make	Model Year	Foam System Type	Class A Tank (Gallon Capacity)	Class B Tank (Gallon Capacity)
1	**Engine 1**	Pierce	2006	Foam Pro	50	0
2	**Engine 2**	Sutphen	2015	WATP	20	40
3	**Engine 4**	American LaFrance	2003	n/a	0	0
4	**Engine 5**	Sutphen	2014	WATP	20	40
5	**Engine 7**	Pierce	2006	Foam Pro	50	0
6	**Engine 8**	Sutphen	2009	WATP	25	40
7	**Engine 10**	Sutphen	2015	WATP	20	40
8	**Engine 11**	Sutphen	2015	WATP	20	40
9	**Engine 14**	Pierce	2018	WATP	20	40
10	**Engine 17**	Sutphen	2013	WATP	20	40
11	**Engine 18**	Sutphen	2016	WATP	20	40
12	**Engine 19**	Sutphen	2012	WATP	0	300
13	**Engine 20**	Sutphen	2012	WATP	0	300
14	**Engine 21**	Sutphen	2014	WATP	20	40
15	**Engine 40**	Sutphen	2015	WATP	20	40
16	**Engine 41**	Sutphen	2016	WATP	20	40
17	**Engine 43**	Sutphen	2016	WATP	20	40
18	**Engine 48**	Sutphen	2014	WATP	20	40
19	**Engine 49**	Sutphen	2015	WATP	20	40
20	**Engine 52**	Pierce	2007	Foam Pro	55	0
21	**Engine 53**	Sutphen	2010	WATP	20	40
22	**Engine 56**	Sutphen	2013	WATP	20	40
23	**Engine 61**	Sutphen	2010	WATP	20	40
24	**Engine 63**	Sutphen	2016	WATP	20	40

Two GFD ladder companies currently possess foam systems. All GFD ladder companies are quint apparatus, meaning besides aerial and ground ladders, they also maintain hose, a pump, and a water tank. The two ladder trucks with foam operations are situated in stations to provide unique coverage due to the lack of an engine company being present. Ladder 52 is stationed in a very busy part of the city and is housed with Engine 52. As this district is so active, Ladder 52 catches many incidents while Engine 52 may be on another call. Ladder 52 has a Class A supply tank accompanied by a Foam Pro system. Ladder 59 is stationed without an accompanying engine and responds on many incidents alone. This Ladder has the Williams system and dual tanks containing Class A and Class B foam concentrates. Table 2 shows the GFD's ladder companies and the foam system make up for these apparatuses.

Table 2

Ladder companies of the GFD with foam system and supply data 2018

	Company	Make	Model Year	Foam System Type	Class A Tank (Gallon Capacity)	Class B Tank (Gallon Capacity)
1	**Ladder 5**	Sutphen	2006	n/a	0	0
2	**Ladder 7**	Sutphen	2014	n/a	0	0
3	**Ladder 10**	Sutphen	2015	n/a	0	0
4	**Ladder 11**	Sutphen	2011	n/a	0	0
5	**Ladder 14**	Sutphen	2014	n/a	0	0
6	**Ladder 20**	Sutphen	2010	n/a	0	0
7	**Ladder 21**	Sutphen	2014	n/a	0	0
8	**Ladder 43**	Sutphen	2009	n/a	0	0
9	**Ladder 52**	Sutphen	2009	Foam Pro	20	0
10	**Ladder 57**	Sutphen	2011	n/a	0	0
11	**Ladder 59**	Sutphen	2010	WATP	25	25

The GFD has an impressive apparatus fleet. It is equally impressive that the department has included foam systems with all twenty-three new engines purchased since 2006 and two ladder companies acquired in 2009 and 2010, respectively.

The first questionnaire of three was given to the 72 current line company Captains assigned to engine companies as well as the 15 Lieutenants presently roving and filling in for Captains' absences, totaling 87 subjects. Of these, only 31 answered the request. This questionnaire was put forth to get a feel for what these company officers knew about Class A foam use and to determine if this firefighting product was used as intended. Please refer to Appendix B for the detailed results of this questionnaire as provided by surveymonkey.com.

When asked if they had ever used or directed the use of Class A foam at a structure fire incident within Greensboro 60% responded that they had. One individual responded as unsure to this question. For 60% of those that had used Class A foam, they were then asked to state their deciding factors for using Class A foam application with their tactics and strategies. Six respondents stated it was needed for overhaul operations or wetting down hot spots. Other answers included reasons such as penetration, soaking potential, and descriptions of the types of materials burning.

Providing answers for the first research question, "Why are GFD companies not using Class A foam from their onboard foam systems?", when asked why their respective companies had not used Class A foam at a structure fire 33 % revealed that they had forgotten that it was an option. 20% stated it was due to cost reasons. 16.67 % claimed there was an apprehension to using it. It should be noted that in previous GFD administrations, one would get in trouble for using foam due to the relative costs. The remaining respondents wrote their own "other" response, with a large majority pointing out the Class A foam product was not needed in their opinion.

From this point, this questionnaire was intended to gain answers to the second research question, "What training is needed on the use of Class A foam and the apparatus' foam

systems?" Therefore, the next item asked about formal training on Class A foam products and their use. 73.33% answered they had received training in driver/operator classes or company officer classes. These company officers were probably including any Class B foam training they had attended in the past, as Class B foam training with eductors and foam task force equipment has occurred at the GFD, but not training specific to Class A products has taken place.

Asked about training on their engine's foam system, 60% stated "yes," there had been formal training by the manufacturer, maintenance personnel, or other professional. 33.33% answered "no," and one individual was unsure. These responses may be skewed because the manufacturers of the new apparatus seldom, if ever, conduct training to the line companies at the GFD, and never on the foam systems, except for the two Class B foam pumpers, Engines 19 and 20. If such training occurred, it was to one shift only, with the trainee passing information on to the other shifts. Regardless, this shows a need for formal training on foam systems.

The following item asked if training on Class A foam had been received at periodic company officer training sessions. 73.33 % answered they had not, while 20% stated they had. 6.67% of the responding company officers answered "unsure." It must be noted that training on Class A foam has never occurred at a company officer training refresher, or upgrade, as it is sometimes referred.

The next question asked these officers if they wished for their company to receive periodic training on their apparatus' specific foam system. As expected, 100% of those responding to the questionnaire indicated they would like to receive such training. Following that was an inquiry on whether these officers would like to have periodic training on the use of Class A foam. 93.33% chose the option indicating they would, while a surprising 6.67%, or two individuals, opted they would not wish to receive such training.

The last item on this questionnaire was to test the company officers' knowledge and awareness of what Class A foam product the GFD was currently using. There were four options to choose from, with only one being the correct answer. Of the 31 individuals completing this questionnaire, only 11 chose the right product, which is the Phoschek brand. 61.29% selected the Class B product the GFD uses as their answer. This also shows a need for training.

The second questionnaire was directed to the 96 Engineers of the GFD with the intention of also answering the first two research questions presented with this project. Encompassing a larger number of people, this questionnaire brought about a better return than the first questionnaire in that 53 of the 96 or 55.20%, actually responded to the email and participated in the project. Please see Appendix D for further details on the results of this questionnaire as provided by surveymonkey.com

The first question simply asked if Class A foam had ever been used by the individual, or if they had ever directed its use. 47.17%, nearly half the respondents, replied they had used a Class A foam product while operating at a structure fire in the city of Greensboro. When asked if the individual had ever received formal training on the use of Class A foam, 39 people or 73.58 % answered that they have. Nine responded with "no" and five engineers were "unsure."

The engineers' questionnaire continued by next asking if formal training had been done on the foam system of their particular apparatus. 45.28% said "yes" while 49.06% replied "no." Three engineers were unsure if formal training had ever taken place. As mentioned above regarding the same question given to the company officers, formal training from the truck manufacturer has rarely taken place in the city of Greensboro.

To judge the engineers' confidence with their foam system, the next item asked if they felt if they could train another employee on their foam system. A fraction over half the

respondents stated they could. Surprisingly, 30.19% replied they could not train another employee, and ten people were "unsure."

The GFD holds periodic/semi-annual training for the engineers covering different topics to stay up to date with current trends, etc. When asked about this training and whether or not they had taken part in Class A foam training during one of these sessions, 12 of the 53 respondents stated they had. 71.70% responded by checking the "no" box, and three persons were "unsure" if such training had ever occurred at a class they had attended.

A similar question was posed next regarding training on the onboard foam systems during the semi-annual engineer training. Nine engineers or 16.98% responded they had received training on foam systems, yet 73.58% said they had not participated in such training. Another 9.43% stated they were unsure if such training had ever taken place.

To get a feel for the need of foam system training, the next item of the questionnaire simply asked if the individual would like to take part in periodic training with the foam systems onboard the various fire trucks. As expected, a vast majority of 94.23% claimed they would like such an opportunity. Surprisingly, three of the responding engineers indicated they would not wish to take part. A similar question was also asked regarding periodic training on the use of Class A foam products. All but five individuals stated they would be interested.

Lastly, the engineers were asked which Class A foam product was currently being used by the GFD. There were four products to choose from in a multiple-choice format. Unfortunately, only 20 engineers or 38.46% chose the correct answer, which is the Phoschek brand. There may be some confusion about foam products among the engineers because 57.69% chose the product listed that is the Class B foam concentrate used in the GFD.

The third questionnaire used for this project was sent to fire service personnel from other fire departments or organizations to answer the research question, "How are other departments utilizing Class A foam in their current firefighting operations?" This questionnaire was also designed to address the research question "What policies regarding Class A foam are present and in use within other departments?" Please refer to Appendices G and H for further details on which departments/municipalities received the questionnaire and the Surveymonkey.com results.

The first item on this questionnaire was included in determining the state from which the participating firefighter was from. Of the 54 persons making up the total sample, eight were from North Carolina, two from Indiana, and one each from Virginia, Wisconsin, Kansas, Ohio, Colorado, Illinois, and Washington state. This totaled 17 individuals who participated in this study.

The first inquiry posed to these representatives simply asked if their organization utilized Class A foam during firefighting operations. An impressive 70.59% responded "yes." These individuals were also asked about the Class A foam product their respective department used to see if any used the same foam concentrate as the GFD. Only one respondent indicated they used Phoschek, the same product in use in Greensboro. There was quite a variety listed in the replies to this question, and of course, these responses can be found in Appendix H.

The next question was to find out if the outside agencies used onboard foam systems, eductors with buckets of foam, or a combination of both. 50% of the replies showed a combination was used due to the make-up of their apparatuses. Only 21.43% stated they used onboard foam systems and accompanying foam tanks. The remainder employs eductors paired with a supply of foam concentrate in buckets. Of the departments that have onboard foam

proportioning systems, 76.92% stated their organization formally trains their members on the operation of the foam system, such as by the manufacturer's service representative.

Interestingly when asked "Does your department have a training program for utilizing Class A foam for firefighting operations?", the responses indicated that 56.25% did not have such a training program. Following that, when asked "Does your department or organization have a policy for Class A foam?" only 37.50%, or six of the 17 respondents, replied "yes."

During the administration of this third questionnaire, Engineer Joe Powell from Eden, North Carolina provided information by email about his department when told about this project. Although he was not able to participate in the Surveymonkey.com questionnaire with the others in the sample, the information he provided is included here in this section. His department has two trucks with onboard foam proportioning systems. He stated his department has no policy on Class A foam use; however, all personnel are trained and must "demonstrate proficiency once a year" with the onboard foam systems. The Eden Fire Department covers Class A foam in its driver/operator program, and a practical evolution may be drawn during driver/operator candidate testing (J. Powell, personal communication, October 8, 2018). See Appendix J for Engineer Powell's response.

Discussion

Fire suppression and protecting life have always been the main objectives of the fire service. If ever there were a product that could assist fire companies with improving on these objectives, we most certainly should acquire it. Class A foam is such a product, and the GFD is fortunate to have it readily available for use. Since 2006 the City of Greensboro has purchased twenty-three new fire engines, each with its own on-board foam proportioning system. The department is not using these systems and this foam product to their fullest potential.

This project set out to find out why the engine companies of the GFD were not using the Class A foam stored on their apparatus. The results of the questionnaires directed to the Captains of engine companies revealed that confusion might exist regarding the use of Class A foam. When asked about the times Class A foam was not used on a structure fire, many of the respondents stated to the fact the foam was not necessary, and water alone was adequate. There were also replies that suggested the company officer simply forgot about the Class A foam and did not remember it was an option. These instances indicate there may be a need for further education on the Class A foam product and its advantages. This is what Hubert alluded to in his article for Fire & Rescue when he wrote that foam usage has "been a confusing and largely misunderstood firefighting tactic within the fire service" (Hubert, 2014, p. 40).

GFD members who responded to the questionnaires, both Captains and Engineers, stated themselves and their companies had been formally trained in the use of Class A foam and the foam systems belonging to their engines. Having been a former Engineer as well as a former Captain in the GFD, the researcher can attest that such training does not occur. The only formal training witnessed by the researcher was when two 300-gallon Class B foam pumpers were purchased in 2012. At that time a representative from Williams Fire & Hazard control visited with the crews of Engines 19 and 20 to instruct them on their respective engines. As new trucks get ordered, a department should remember to "make sure your specifications include training on all fixed components as part of the delivery package. Then make sure the training occurs" (Wilmoth, 2011, p. 3).

Although some respondents to the questionnaires stated they had received other formal training on foam, such as in driver/operator certification courses, it is believed they recalled

training with eductors and buckets, not the foam proportioning systems currently supplied by the GFD.

As expected, the questionnaires revealed that formal training has not occurred at regularly scheduled officer training sessions or engineer refreshers. Also, as expected, the individuals indicated there is a desire for future training in just such a method. Additionally, there was an indication of a strong desire for engine companies to receive periodic training on the foam pumping system included in the pumping arrangement with their truck. This information is well received by the researcher because it shows a shortcoming of the GFD's training efforts. It was made clear in Fire Engineering that "firefighters must know how to their particular foam system operates and be confident in its performance" (Cotner, 2007, p. 121). Because there was an indication for the implementation of Class A foam training, this verifies the need for a policy that includes a training plan.

Class A foam has been present for a few decades, and the GFD now has the technology to flow Class A foam concentrate with water on demand. There is not a good reason to not use this firefighting product. The inaccuracies about foam that have gone around the fire service and the lack of education and training reasons mentioned by Klassen (2012) should be put to rest, as Greensboro has adopted Class A use by buying the foam systems and installing them on new fire engines.

The fear of using Class A foam due to cost was found to be a factor for not using the product with some GFD officers responding to the questionnaire. But Class A foam is relatively inexpensive when one looks at the very low flow rates needed to utilize it in a fire stream. Hubert (2014) reminded his readers that money could be saved by using Class A foam because fires will be put out quicker with smaller amounts of water. With Class A foam use the overhaul

process becomes easier, and crews can be returned to service less fatigued in a shorter amount of time. The approximate cost of the Phoschek Class A foam for the GFD has been around $16.00 to $17.00 per gallon (V. Atkins, personal communication, September 29, 2018). Appearing expensive at first, one must understand that 0.5% or less of foam concentrate would go a long way when added to a hose line. For example, a truck with a 20-gallon foam tank deploys a hose line flowing 100 GPM. Using the foam proportioner set to 0.5% and adding Class A foam to the stream, the hose line will then flow 99.5 gallons of water and 0.5 gallons of foam per minute. If flowed continuously, that foam supply will last for 40 minutes, a lot of firefighting time.

A significant indicator that a policy and training regimen for Class A foam use is needed for the GFD was found in the questionnaires to both company officers and the engineers. Both groups were asked the same question in a multiple-choice format to identify the Class A foam concentrate currently used by the GFD. All engines use the same product, so it was surprising to see the low numbers of correct responses. Only 38.46 % of the engineers and 35.48% of the officers answered correctly. This fact alone shows that more needs to be done in educating personnel on Class A foam.

Numerous manufacturers are marketing their brand of Class A foam concentrate. This fact was found to be evident in the questionnaire administered to the 54 outside departments. Despite using products different from the GFD, nearly 77% of these organizations are conducting formal training on their onboard foam proportioning systems and half reported doing training on Class A foam itself. Based on this information, and the fact that 37.5% have a policy in place, Greensboro should organize such training and create a GOG. Liebson, (1996) addressed the notion that policies are needed when adopting Class A foam. A fire department cannot just buy new equipment and supplies without incorporating new policies and training.

Information gained on policy development during the literature review was deemed helpful for this project. Many recommendations included the research of the proposed policy's topic, just as is occurring with this ARP. Looking at the business world, law enforcement, and federal agencies, the researcher discovered the procedures for policy development were similar with very subtle differences between the groups' methods. Once the need for a new policy is identified, and the research is complete, the document can be put in place if accompanied by proper communication to all involved (SHRM, 2018). Then after some time, a review can be conducted to update or change the policy as needed (EPA, 2007).

Recommendations

As the municipality of Greensboro, NC has acquired twenty-three fire engines and two quint/ladder trucks with onboard foam systems since 2006; it is recommended the department adopt the proposed Class A foam GOG that is outlined in Appendix K to encourage increased Class A foam usage during structure fire incidents. This document will serve as the basis for an understanding of the department's Class A foam use as it lists multiple advantages of the product. With this GOG, the result will be to educate members of the GFD on the strengths of utilizing Class A foam during fire attack at structure fire events. The increased use of Class A foam is recommended to improve structural firefighting success rates, to reduce instances of fire rekindling, and to improve firefighter safety simultaneously.

The proposed GOG includes Class A foam concentrate flow rates that are to be utilized for different firefighting situations. These flow rates were presented by Mitch Huber in his article for Fire & Rescue. The flow rates to be considered by the GFD as recommended by Hubert are listed below:

- Initial Fire Attack: 0.3 - 0.5%

- Overhaul: 0.2 – 0.3%
- Fire Brake with wildland fire: 0.75%
- Exposure Protection: 1.0% (Hubert, 2015, p. 20)

It is recommended that Class A foam be presented better and highlighted during basic recruit training. The current outline used for instructing the recruits about foam should be rewritten to include the distinct differences between Class A and Class B foams. Additional instruction is recommended on why Class A foam is advantageous with practical demonstrations being conducted when possible. While the continued instruction of foam eductor operation is important to teach the basics of foam proportioning, extended class time should include details of the on-board foam systems and how they can be instrumental in today's firefighting.

The GFD engineer promotional processes should include written test questions specific to Class A foam. The addition of this topic to the written exam materials will ensure prospective engineer candidates are spending time learning the purpose and advantages of Class A foam. The engineer promotional process should also contain practical evolutions on operating and metering the onboard foam systems currently installed on the engines of the GFD. Testing this proficiency will ensure the candidates are learning to use the apparatus as intended.

It is recommended that Class A foam instruction and discussion be included in one of the GFD's semi-annual engineer refresher sessions led by the officers of the training division. It is then suggested further that proficiency evaluations be held at these semi-annual training sessions to ensure smooth and adequate operation of the engines' foam proportioners. It must also be supported that continued training on the foam systems, and Class A foam usage shall be held at the engine company level. This addition ensures company officers continue to stay abreast of all

firefighting techniques while firefighters who may serve as acting engineers remain trained on their engine's foam system.

With each new apparatus that is purchased by the GFD, it should be included with the specifications that each order includes formal training by the manufacturer of all working parts of the apparatus. The manufacturer's representative will come to Greensboro to conduct the initial training session. This change shall include education on the onboard foam proportioning system, regardless of the manufacturer. All personnel assigned to said apparatus will be required to take part in this formal training session irrespective of rank.

The last recommendation is to update the GFD's record management system (RMS) to include a location on the fire reports for indicating whether or not Class A foam was used on structure fire events. The amount of foam concentrate used per each incident can be reported allowing for improvements with logistics, purchasing, and supply management. This added part to the GFD fire incident data will keep track of foam usage trends over time, notating success rates and validating the purchase of fire engines with foam proportioning systems.

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Appendix A

Email to Company Officers of the GFD for questionnaire

From: Faulk, Daniel
Sent: Monday, October 29, 2018 12:18 PM
To: Engine Captains
Cc: Lieutenants
Subject: Questionnaire request for GFD Engine Company Officers

Engine Captains and Lieutenants, I hope you are all doing well!

I am currently working on an Applied Research Project for the National Fire Academy's Executive Fire Officer Program and I would like to have your valuable input. I am gathering data on Class A Foam and its use within our department. Lieutenants, although you do not yet have permanent assignments and occasionally ride with our ladder companies, I would still like your assistance with my research.

Please take a few minutes and complete an online questionnaire through surveymonkey.com.

The link to the questionnaire is: https://www.surveymonkey.com/r/RH8XHPT

Thank you in advance for your time! I really appreciate your input!

Stay safe,

Dan

Daniel W. Faulk

Battalion Chief
Greensboro Fire Department
Battalion 5
Third Platoon
336-279-1440
336-430-6005

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Please note that email sent to and from this address is subject
to the North Carolina Public Records Law and may be disclosed to third parties.

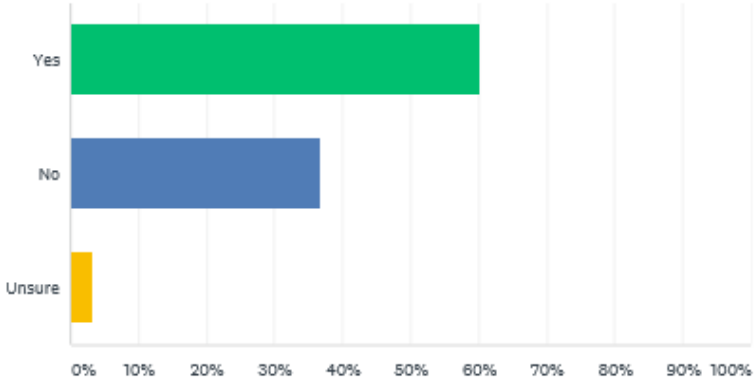
Appendix B

Questionnaire 1: Directed to GFD Co. Officers with Surveymonkey.com results

Questionnaire 1, Question 1:

Have you ever used or directed the use of Class A Foam at a structure fire incident in the City of Greensboro?

Answered: 30 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	60.00%	18
No	36.67%	11
Unsure	3.33%	1
TOTAL		30

Questionnaire 1, Question 2:

If you have used or directed the use of Class A Foam at a structure fire incident, what were the deciding factors for applying it to your fire fighting strategies and tactics?

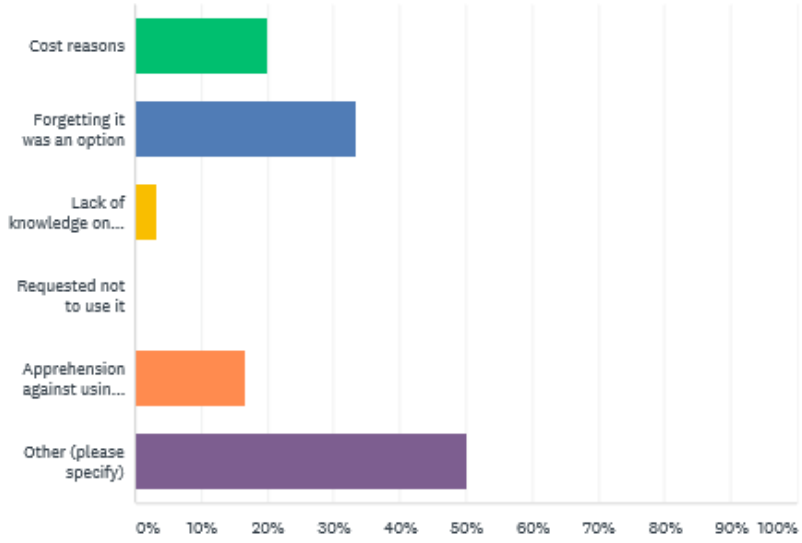
Answered: 24 Skipped: 7

1. fire was deep in remnants of a collapsed structure, needed penetration ability
2. For greater penetration at this fire.
3. overhaul of deep seated fire
4. extensive overhaul
5. suppression operations
6. HIGH PROBABILITY OF REKINDLE
7. I have used Class A foam in overhaul operations as a officer. But as my time as an Engineer I placed it on the lines for fire attack.
8. NA
9. N/A
10. to assist in overhaul
11. Complete overhaul operations
12. Fire in insulation in attic, needed Foam for complete extinguishment.
13. na
14. Used for bales of fabric that was hard to penetrate.
15. Type of material burning
16. Wetting down remaining hot spots.
17. n/a
18. Haven’t used
19. overhaul difficulties
20. Large amount of contents and a stubborn attic fire.
21. Wetting Agent to assist with Fire Suppression
22. Not Applicable
23. Soaking potential
24. It was a hoarding issue and we were having trouble getting the fire completely put out.

Questionnaire 1, Question 3:

When your company has not used Class A Foam at a structure fire, what were the deciding factors for not using it? Check all that apply.

Answered: 30 Skipped: 1



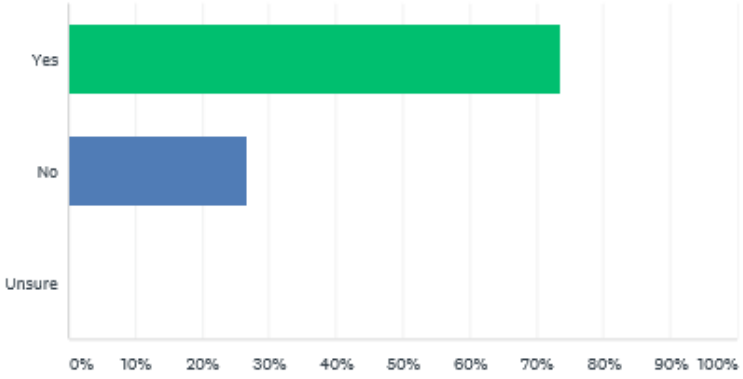
ANSWER CHOICES		RESPONSES	
Cost reasons		20.00%	6
Forgetting it was an option		33.33%	10
Lack of knowledge on its use		3.33%	1
Requested not to use it		0.00%	0
Apprehension against using it		16.67%	5
Other (please specify)	Responses	50.00%	15
Total Respondents: 30			

1. didn't feel it was necessary
2. Fire was controlled adequately without it
3. Fire was under control with water application
4. Not necessary put out fire.
5. didn't have a need
6. Either did not have it or need it for the operation
7. Did not need it.
8. Did not need it
9. Water only was sufficient
10. Easier to put out with water
11. Habit. Water seemed to be plenty effective.
12. n/a
13. Have not had the opportunity.
14. Didn't feel it was worth having the clean up associated with it.
15. Lack of policy and historical use of the GFD utilizing class A foam at structure fires.

Questionnaire 1, Question 4:

Have you been formally trained on the use of Class A foam products, such as during initial recruit training, in OSFM Driver/Operator classes, or Company Officer classes?

Answered: 30 Skipped: 1

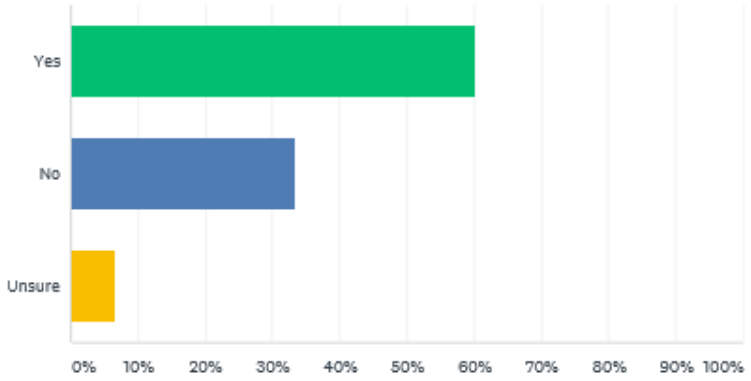


ANSWER CHOICES	RESPONSES	
Yes	73.33%	22
No	26.67%	8
Unsure	0.00%	0
TOTAL		30

Questionnaire 1, Question 5:

Has your company been formally trained on the use of your apparatus' foam system, such as by the manufacturer, maintenance personnel, or other professional ?

Answered: 30 Skipped: 1

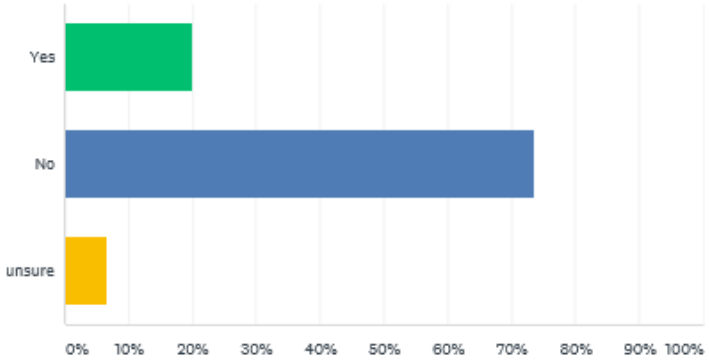


ANSWER CHOICES	RESPONSES	
Yes	60.00%	18
No	33.33%	10
Unsure	6.67%	2
TOTAL		30

Questionnaire 1, Question 6:

Have you received training on Class A foam use during Company Officer Upgrades or In-Service Training?

Answered: 30 Skipped: 1

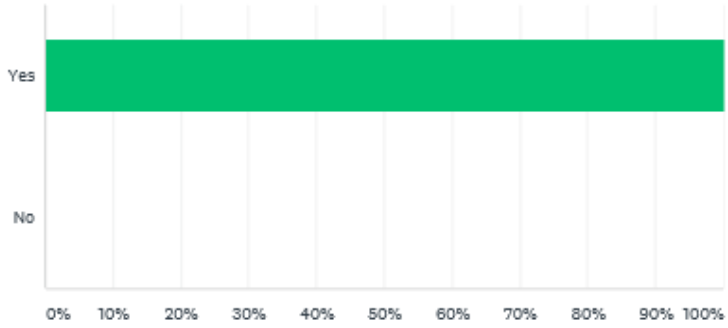


ANSWER CHOICES	RESPONSES	
Yes	20.00%	6
No	73.33%	22
unsure	6.67%	2
TOTAL		30

Questionnaire 1, Question 7:

Would you like for your company to receive periodic training on your apparatus' foam system?

Answered: 30 Skipped: 1

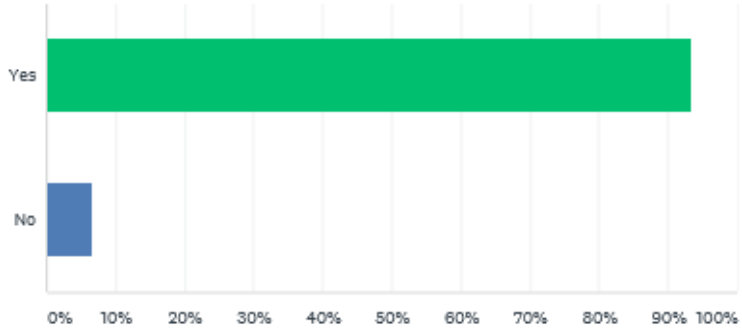


ANSWER CHOICES	RESPONSES	
Yes	100.00%	30
No	0.00%	0
TOTAL		30

Questionnaire 1, Question 8:

Would you like to receive periodic training on the use of Class A foam?

Answered: 30 Skipped: 1

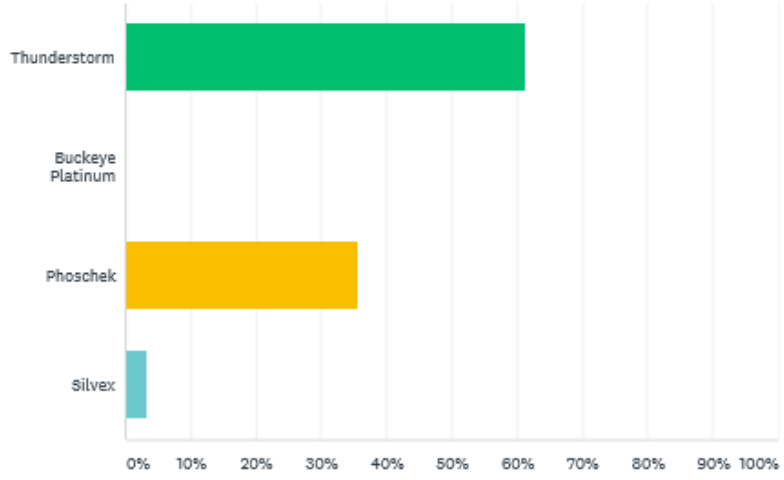


ANSWER CHOICES	RESPONSES	
Yes	93.33%	28
No	6.67%	2
TOTAL		30

Questionnaire 1, Question 9:

Which of the following is the Class A Foam product currently used by the GFD?

Answered: 31 Skipped: 0



ANSWER CHOICES	RESPONSES	
Thunderstorm	61.29%	19
Buckeye Platinum	0.00%	0
Phoschek	35.48%	11
Silvex	3.23%	1
TOTAL		31

Appendix C

Email to Engineers of the GFD for questionnaire

From: Faulk, Daniel
Sent: Thursday, October 25, 2018 12:47 PM
To: Engineers
Subject: Questionnaire request for GFD Engineers

Engineers of the GFD, I hope you are doing well!

I am currently working on an Applied Research Project for the National Fire Academy's Executive Fire Officer Program and I would like to have your valuable input. I am gathering data on Class A Foam and its use within our department.

Please take a few minutes and complete an online questionnaire through surveymonkey.com.

The link to the questionnaire is: https://www.surveymonkey.com/r/6BQT5LN

Thank you in advance for your time! I really appreciate your input!

Stay safe,

Dan

Daniel W. Faulk

Battalion Chief
Greensboro Fire Department
Battalion 5
Third Platoon
336-279-1440
336-430-6005

==========

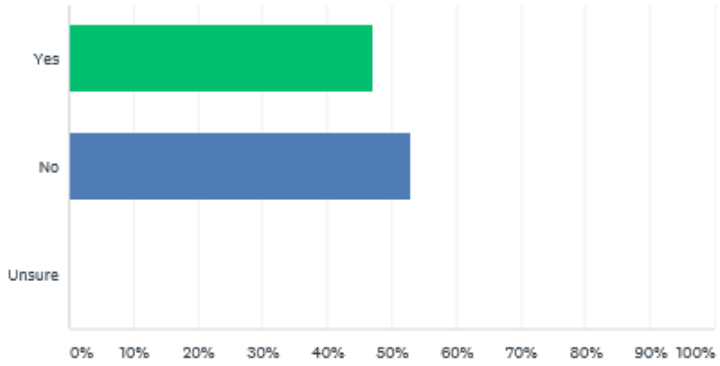
Appendix D

Questionnaire 2: Directed to GFD Engineers with Surveymonkey.com results

Questionnaire 2, Question 1:

Have you ever used or directed the use of Class A foam at a structure fire incident in the City of Greensboro?

Answered: 53 Skipped: 0

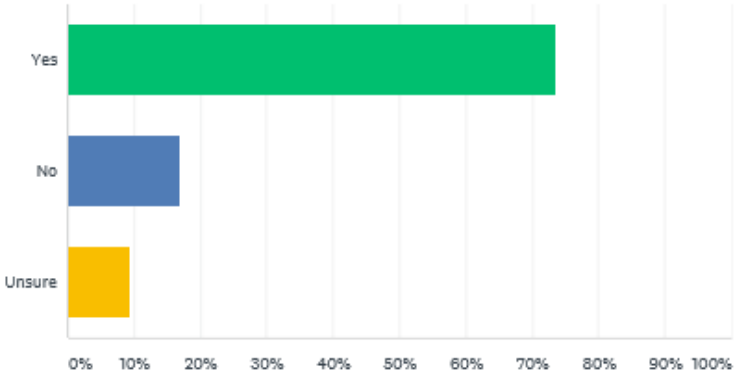


ANSWER CHOICES	RESPONSES	
Yes	47.17%	25
No	52.83%	28
Unsure	0.00%	0
TOTAL		53

Questionnaire 2, Question 2:

Have you been formally trained on the use of Class A foam products, such as during initial recruit training or in OSFM Driver/operator classes?

Answered: 53 Skipped: 0

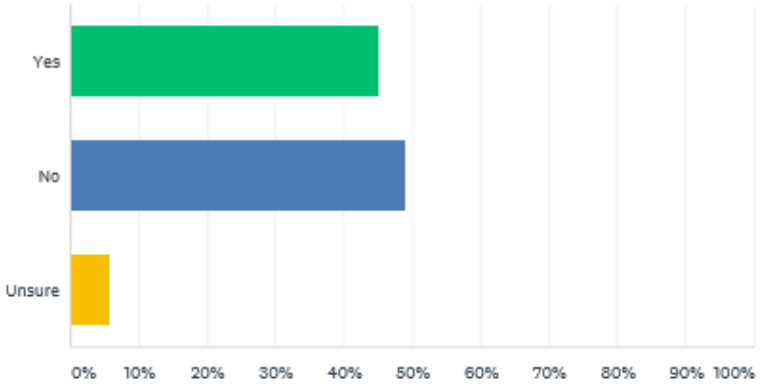


ANSWER CHOICES	RESPONSES	
Yes	73.58%	39
No	16.98%	9
Unsure	9.43%	5
TOTAL		53

Questionnaire 2, Question 3:

Have you been formally trained on the use of your apparatus' foam system, such as by the manufacturer, maintenance personnel, or other professional ?

Answered: 53 Skipped: 0

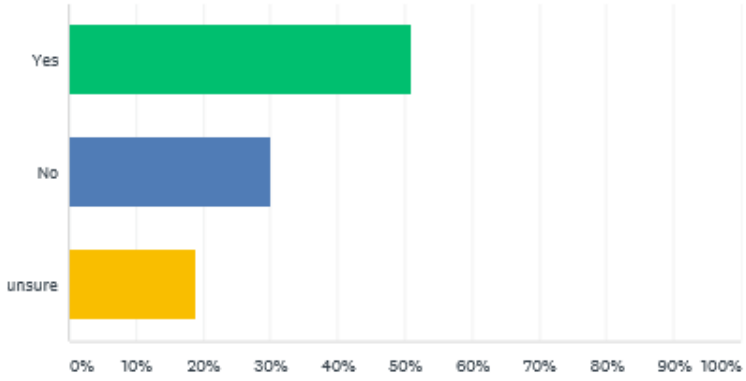


ANSWER CHOICES	RESPONSES	
Yes	45.28%	24
No	49.06%	26
Unsure	5.66%	3
TOTAL		53

Questionnaire 2, Question 4:

Do you feel you could train another employee on using your apparatus' foam system?

Answered: 53 Skipped: 0

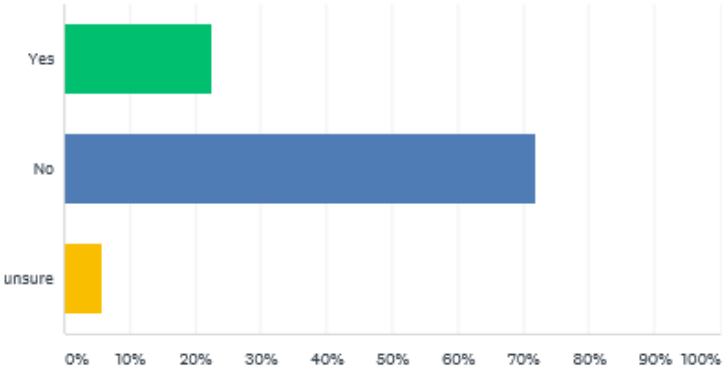


ANSWER CHOICES	RESPONSES	
Yes	50.94%	27
No	30.19%	16
unsure	18.87%	10
TOTAL		53

Questionnaire 2, Question 5:

Have you received training on Class A foam use during semi-annual engineer upgrades?

Answered: 53 Skipped: 0

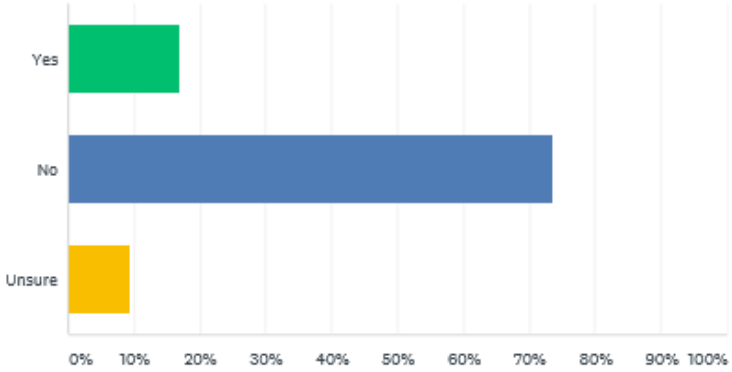


ANSWER CHOICES	RESPONSES	
Yes	22.64%	12
No	71.70%	38
unsure	5.66%	3
TOTAL		53

Questionnaire 2, Question 6:

Have you received training on your apparatus' foam system during semi-annual engineer upgrades?

Answered: 53 Skipped: 0

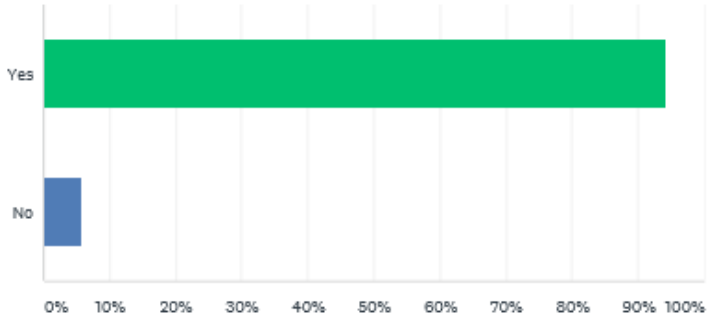


ANSWER CHOICES	RESPONSES	
Yes	16.98%	9
No	73.58%	39
Unsure	9.43%	5
TOTAL		53

Questionnaire 2, Question 7:

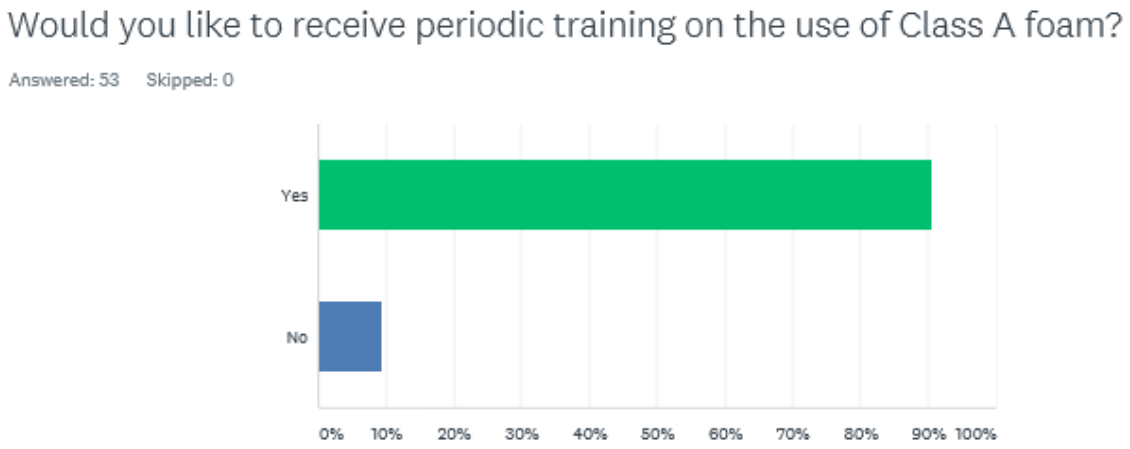
Would you like to receive periodic training on your apparatus' foam system?

Answered: 52 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	94.23%	49
No	5.77%	3
TOTAL		52

Questionnaire 2, Question 8:

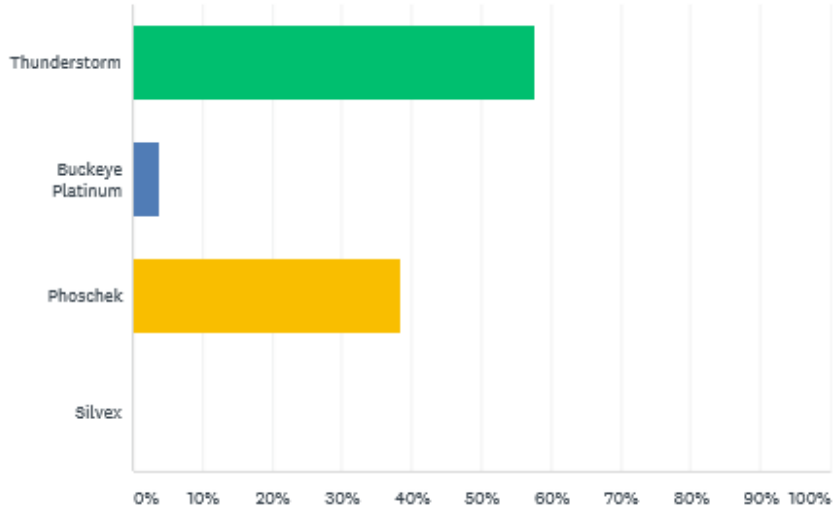


ANSWER CHOICES	RESPONSES	
Yes	90.57%	48
No	9.43%	5
TOTAL		53

Questionnaire 2, Question 9:

Which of the following is the Class A Foam product currently used by the GFD?

Answered: 52 Skipped: 1



ANSWER CHOICES	RESPONSES	
Thunderstorm	57.69%	30
Buckeye Platinum	3.85%	2
Phoschek	38.46%	20
Silvex	0.00%	0
TOTAL		52

Appendix E

Email #1 to members of outside fire organizations

Fellow members of the PFFPNC,

This is Dan Faulk, Treasurer with the Professional Firefighters of Greensboro and I am contacting you due to your involvement with the Professional Fire Fighters and Paramedics of North Carolina. If you have just a few moments, I would like your assistance.

I am currently working on an Applied Research Project for the National Fire Academy's Executive Fire Officer Program and would like for you to answer a short questionnaire. I am doing my project on the use of Class-A Foam during firefighting operations.

I have developed a questionnaire on surveymonkey.com to assist with my research for the project.

If you have just a few moments, I would like your valuable input. Please click the link below to access the survey:

https://www.surveymonkey.com/r/NYCPXHP

Thank you so much for assisting with this research project.

Dan Faulk, Treasurer
Professional Fire Fighters of Greensboro
IAFF Local 947
dfaulk@triad.rr.com
336-312-0737

Appendix F

Email #2 to members of outside fire organizations

Hello,

I hope you are all doing well and having good luck with your Applied Research Projects. I too am collecting data for my year-3 ARP and would like to have your input. I am researching the use of Class A Foam so that I can develop a policy for my department.

If you have just a few minutes, I would very much appreciate your time.

Please click on the link below to proceed to the survey:

https://www.surveymonkey.com/r/NYCPXHP

Thank you for assisting me with this project!

Dan Faulk, Battalion Chief
Greensboro Fire Department
Battalion 5, C-Shift
dfaulk@triad.rr.com

Appendix G

Outside fire organizations receiving questionnaire

NC Fire Departments receiving questionnaire:

1. Hickory, NC
2. Lexington, NC
3. New Hanover County, NC
4. Gastonia, NC
5. High Point, NC
6. Wilmington NC
7. Kernersville, NC
8. Winston Salem, NC
9. Kinston, NC
10. Greenville, NC
11. Fayetteville, NC
12. Salisbury, NC
13. Boone, NC
14. Outerbanks, NC
15. Jacksonville, NC
16. Lenoir, NC
17. Statesville, NC
18. King, NC
19. Mooresville, NC
20. Lincolnton, NC
21. Asheville, NC
22. Cabarrus County, NC
23. Chapel Hill, NC
24. Rockingham, NC
25. Raleigh, NC
26. Brunswick County, NC
27. Durham, NC
28. Goldsboro, NC
29. Charlotte, NC
30. Eden, NC
31. Lewisville, NC

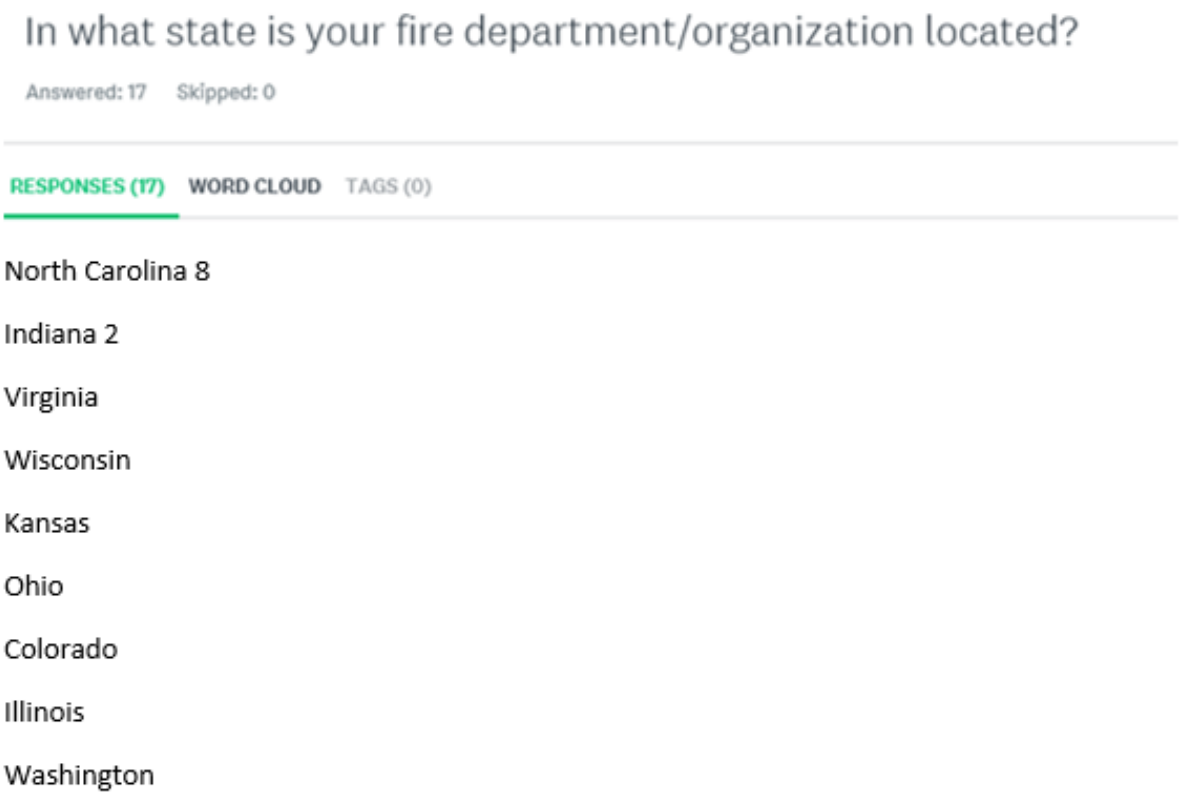
Other Departments receiving questionnaire:

1. Brookfield, WI
2. Linsey, OH
3. Shawnee Heights, KS
4. Oviedo, FL
5. Fort Worth, TX
6. West Bloomfield, MI
7. Bartlett, IL
8. Muscatine, IA
9. Santa Cruz County, CA
10. Sierra Vista, AZ
11. Grand Chute, WI
12. Cal Fire, CA
13. Westmont, IL
14. Tacoma, WA
15. Virginia Beach, VA
16. Ellis County, KS
17. Branson, MO
18. Stanilaus District, CA
19. Newport News, VA
20. Carmel, IN
21. Indianapolis, IN
22. Black Hawk, CO
23. DeKalb, IL

Appendix H

Questionnaire 3: Directed to representatives from outside fire organizations with Surveymonkey.com results

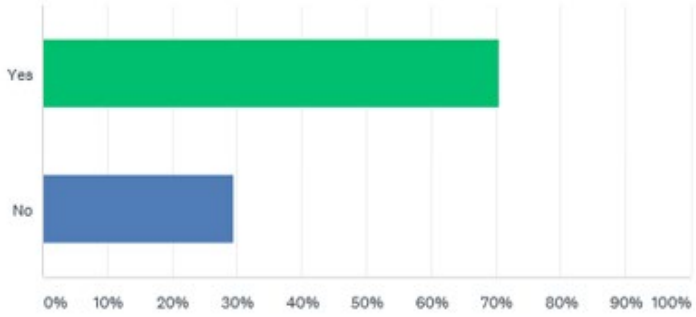
Questionnaire 3, Question 1:



Questionnaire 3, Question 2:

Does your fire department / organization utilize Class A Foam for firefighting operations?

Answered: 17 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	70.59%	12
No	29.41%	5
TOTAL		17

Questionnaire 3, Question 3:

If yes, what Class A Foam product does your organization use?

Answered: 15 Skipped: 2

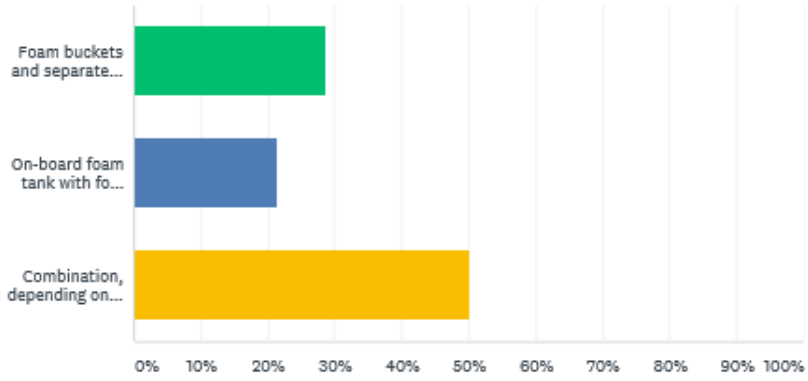
RESPONSES (15) WORD CLOUD TAGS (0)

1. Phoschek
2. Foam buckets and onboard systems
3. US Forestry Service Contract products
4. The brand changes based on price. We send out for bid annually.
5. To clarify the last question, we very rarely use foam - It is too expensive - when we do use it (I have used it once in my entire career) we use ColdFire
6. Universal Gold
7. ?
8. N/A
9. Silvex Plus
10. We are currently using up our supply of F500 which is a multi use product
11. Numerous brands
12. AFFF
13. Varies
14. N/A
15. Fire Aide

Questionnaire 3, Question 4:

If your fire department uses Class A Foam for firefighting operations, do you maintain buckets with eductors, on-board foam tanks with a foam system, or a combination depending on the apparatus?

Answered: 14 Skipped: 3

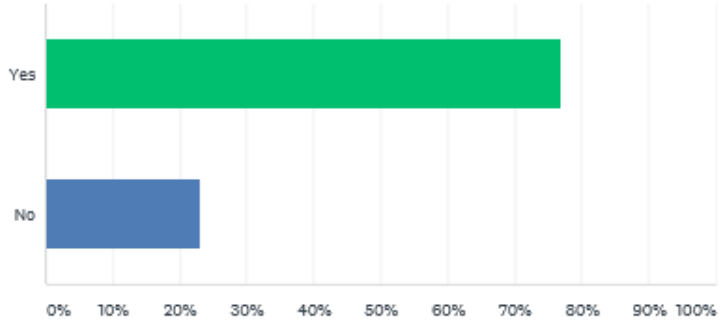


ANSWER CHOICES	RESPONSES	
Foam buckets and separate foam eductors	28.57%	4
On-board foam tank with foam system operated at the pump panel	21.43%	3
Combination, depending on the apparatus	50.00%	7
TOTAL		14

Questionnaire 3, Question 5:

If you have on-board foam proportioning systems, are your personnel formally trained on the operation of the system, such as by a manufacturer's service representative?

Answered: 13 Skipped: 4

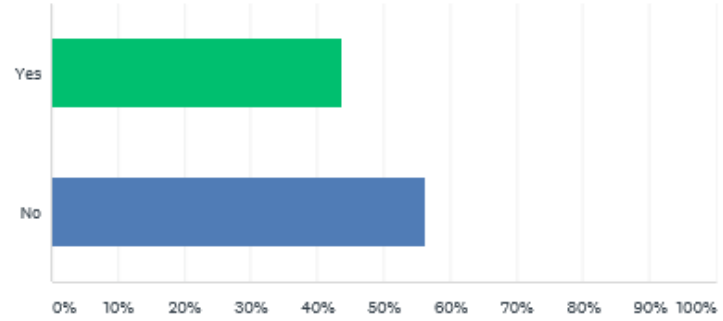


ANSWER CHOICES	RESPONSES	
Yes	76.92%	10
No	23.08%	3
TOTAL		13

Questionnaire 3, Question 6:

Does your department have a training program for utilizing Class A Foam for firefighting operations?

Answered: 16 Skipped: 1

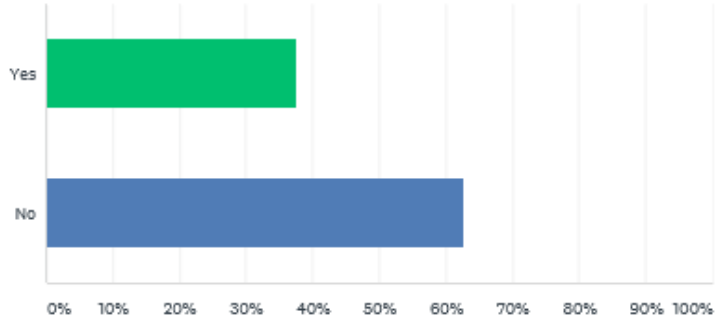


ANSWER CHOICES	RESPONSES	
Yes	43.75%	7
No	56.25%	9
TOTAL		16

Questionnaire 3, Question 7:

Does your department or organization have a policy for Class A Foam, such as when to use and at what rate?

Answered: 16 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	37.50%	6
No	62.50%	10
TOTAL		16

Appendix I

Email with GFD Training Battalion Chief Brett Combs

From: Faulk, Daniel
Sent: Saturday, October 06, 2018 5:17 PM
To: Combs, Michael <Michael.Combs@greensboro-nc.gov>
Subject: Request

Chief Combs,

I am doing a project for the National Fire Academy's Executive Fire Officer Program regarding the use of Class A Foam.

Could you possibly share with me the recruit training outlines used for teaching foam during the GFD academy?

Thanks for your help,

Dan

Daniel W. Faulk

Daniel W. Faulk, Battalion Chief
Greensboro Fire Department
Battalion 5, C-Shift

From: Combs, Michael
Sent: Monday, October 08, 2018 6:30 AM
To: Faulk, Daniel <Daniel.Faulk@greensboro-nc.gov>
Subject: RE: Request

Chief,

I pulled this part from our hose streams and appliances outline. I didn't think you wanted all the other stuff. Let me know if you need anything else.

X. FOAM FIRE STREAMS AND EDUCTOR CALCULATIONS

A. Methods by which foam controls the hazards

1. Smothering – prevents air and flammable vapors from combining.
2. Separation – intervening between the fuel and the fire.
3. Cooling – lowering the temperature of the fuel and adjacent surfaces.
4. Penetrating — Lowers the surface tension of water and allows it to penetrate deep-seated fires.

B. Application Techniques

1. Roll-On Method

2. Bank-Down Method

3. Rain Down Method

4. Never Plunge Foam

B. Production of Foam

1. Foam Concentrate + Water and Air + Mechanical Agitation = Finished Foam “Foam Tetrahedron”

2. Foam Concentrate – The raw liquid as it sits in its storage container.

3. Foam Proportioner – The device that injects the correct amount of concentrate into the water stream to make the foam solution

4. Foam solution – The mixture of foam concentrate and water that is discharged from the proportioner and passed through the hoseline.

5. Finished Foam – The completed product after the foam solution reaches the nozzle and air is introduced into the stream.

C. Checklist if Eductor fails to operate

1. Partially closed nozzle

2. By-pass valve open

3. Improperly cleaned equipment, clogged with foam.

4. Hose lay to long

5. Metering valve improperly set

6. Nozzle elevated too far above eductor

7. Kink in hoseline

D. Types of Fuels

1. Hydrocarbon Fuels – Fossil fuels, examples are gasoline, diesel fuel, kerosene, aviation fuel, etc…These fuels require foam application rates at 1% for effective blanketing and extinguishment. Application rates above 1% are a waste of foam concentrate.

2. Polar Solvent Fuels – Polar refers to the molecular structure of the substance. Many of the fuels that fall into this category contain alcohol. Examples include acetone, keytone, etc… These fuels require a

higher application rate, 3%, because they tend to attack and destroy the foam blanket.

E. Types of proportioners

1. Portable:

a. In-Line Eductors

2. Apparatus Mounted:

a. Around the Pump: Uses pick-up line from discharge side of pump

F. Foam Nozzles:

1. Smooth Bore:

2. Fog Nozzles:

3. Air aspirating Foam Nozzles: JS-10

XI. Types of Foam and their characteristics

C. Thunderstorm (ATC AR-AFFF) FC-601A

1. Can be used through non air-aspirating nozzles.

2. May be stored from 35º to 120º F.

3. Freezing should be avoided.

4. Shelf life of 20 to 25 years when stored at proper temperatures.

G. Phos-Chek WD881 Class A Foams

1. Specifically designed for class A materials.

2. Basically a wetting agent.

3. Low application rates .1 to 1.0 (99 – 99.9% water)

4. May be used with regular water stream equipment.

5. Subject to freezing but can be thawed and used.

6. May be premixed in apparatus booster tank

XII. Foam Equipment

A. In-Line Eductors

1. Operates from a venturi principal.

2. May be attached to the pump panel or directly in the hoselay.

3. Least expensive foam production means

B. Operating Considerations.

1. The eductor must control water flow through the system.

2. The pressure at the outlet must not exceed 70% of the inlet pressure.
3. Back pressure is determined by:
    a. Nozzle Pressure
    b. Friction loss between the nozzle and the eductor.
    c. Pressure created by elevation.
4. Foam solution concentration is only correct at the rated inlet pressure of 200 PSI.
5. Eductors must be properly flushed and maintained after each use.
6. Set metering valve to match the concentrate percentage and the type of fuel.
7. The foam concentrate inlet to the eductor should not be more than 6 feet above the liquid
    surface of the concentrate.

C. ASSEMBLING A FOAM FIRE STREAM

1. Select the proper foam concentrate for the burning fuel.
2. Ensure the foam concentrate on the container and the eductor setting are the same.
3. Attach the eductor to a hose capable of efficiently flowing the capacity of the eductor. If the eductor is attached directly to the discharge outlet, make sure the ball valve gates are completely open and set to the “foam” position.
4. Attach the attack hoseline and the nozzle to the discharge end of the eductor.
5. Open enough buckets of foam concentrate to handle the task.
6. Place the eductor suction hose into the concentrate.
7. Increase the water supply pressure to that required for the eductor

D. Computing Adequate Proportioning of Eductors

With the AFFF we are currently using, we have the capabilities of using it at either 1% or 3% concentrations. This is a unique capability to our department and because of this and the growing increase of hazardous

material incidents all of us are wanting to get in more practice time with our eductors and foam. Because of the expensive price of this foam, practice with it is virtually impossible. The only means we have at present to practice with eductors is probably the best means of insuring that our eductors are proportioning correctly. This means is by substituting water for foam and timing the eductors capability of draining a five gallon container of water. The procedure is as follows:

1. Computing 1% proportioning

a. 95 GPM eductor

(95 GPM) (.01 concentrate) = .95 gallons conc./minute

60 divided by .95 = 63

60 seconds = 1 gallons every 63 seconds .95 gal/min

i. Therefore a 5 gallon container of foam should be used up in approximately 5 minutes and 15 seconds.

b. 250 GPM eductor

(250 GPM) (.01 concentrate) = 2.5 gallons conc./minute

60 divided by 2.5 = 24

60 seconds = 1 gallon every 24 seconds 2.5 gal/min

i. Therefore a 5 gallon container of foam should be used up in approximately 2 minutes.

2. Computing 3% proportioning

a. 95 GPM eductor

(95 GPM) (.03 concentrate) = 2.85 gallons conc./minute

60 divided by 2.85 = 21

60 seconds = 1 gallon every 21 seconds. 2.85 gal/min

i. Therefore a 5 gallon container of foam should be used up in approximately 1 minute and 45 seconds at 3% if the eductor is proportioning correctly.

b. 250 GPM eductor

250GPM) (.03 concentrate) = 7.5 gallons conc./minute

60 divided by 7.5 = 8

60 seconds = 1 gallon every 8 seconds 7.5 gal/min

i. Therefore a 5 gallon container of foam should be used in approximately 40 seconds at 3 % if the eductor is proportioning correctly.

Brett Combs
Greensboro Fire Department
Battalion Chief, Training Division
1510 N. Church St / Greensboro / NC / 27405
michael.combs@greensboro-nc.gov
Office: 336-574-4086
Mobile: 336-430-6040

From: Faulk, Daniel
Sent: Monday, October 08, 2018 8:10 AM
To: Combs, Michael <Michael.Combs@greensboro-nc.gov>
Subject: RE: Request

Thanks so much! I really appreciate your help!

Does the Training Division do any practicals about foam during the recruits' pump training?

Dan

From: Combs, Michael
Sent: Monday, October 08, 2018 8:53 AM
To: Faulk, Daniel <Daniel.Faulk@greensboro-nc.gov>
Subject: RE: Request

No sir.

Brett Combs
Greensboro Fire Department

Battalion Chief, Training Division
1510 N. Church St / Greensboro / NC / 27405

Appendix J

Email Correspondence with Eden, NC Fire Department Engineer Joe Powell

Dan Faulk

From: Joe Powell <truck1feo@yahoo.com>
Sent: Monday, October 8, 2018 1:08 PM
To: Dan Faulk
Subject: Re: Requesting the assistance of PFFPNC Members....
Attachments: Eden Fire Department foam questionaire.docx

Here you go, good luck,

Joe

Eden Fire Department

Engineer Joe Powell

1. Does your fire department utilize Class A foam for firefighting operations?
   Yes

2. If yes, do you maintain buckets and eductors or on-board foam tanks with a foam system?

   Both.

   Engines 1,3, 6; Ladders 1 and 2 have eductors & buckets

   Engines 2 and 4 each have on board foam tanks

3. If you have on-board foam systems, are your personnel formally trained on their use?

   All personnel are trained on their use and demonstrate proficiency once a year. Just had our annual Foam class review and practicals last month

4. Does your department have a policy for Class A foam use, such as when to use and at what rate?

   No policy. Each incident is evaluated by Incident commander.

5. Does your department have a training program for utilizing Class A foam?

   Yes, it is covered in driver/operator program and is a practical that may be drawn during driver/operator candidate testing.

Appendix K

Proposed Class A Foam General Operating Guideline

Greensboro Fire Department General Operating Guidelines		
GOG 06.34: Class A Foam	**Branch:** Emergency Services	Page 1 of 2
Fire & Emergency Service Self-Assessment Manual Category 5		

Guideline

Greensboro Fire Department apparatus are now outfitted with foam proportioning systems and accompanying foam supply tanks containing Class A and Class B foams. With such, pump operators are able to easily add firefighting foam to deployed hose lines. The purpose of this General Operating Guideline (GOG) is to provide direction on the use of and training on Class A foam products designed for fires involving ordinary combustibles.

The use of Class A foam during structure fire incidents (and outside/wildland urban interface fire events) will assist with the extinguishment of the fire and provide added safety for the firefighting crews.

- The Class A foam product to be used by the GFD shall be “Phoschek”.
- Class A foam is faster than plain water in fire suppression and extinguishment.
- Class A foam uses water efficiently and conservatively, enhancing the cooling ability of water as well as deeply penetrating burning and smoldering materials.
- The foam adheres to most surfaces and is retained much longer than plain water.
- According to NFPA 1145, mix ratios of 0.1 to 1.0 “reduce surface tension values below that exhibited by water, resulting in improved coverage by the applied foam and wetting of the fuel.”
- Class A foam use reduces interior exposure time for fire companies at structure fires.
- Class A foam creates a protective blanket assisting with exposure protection.
- Class A foam has been shown to be effective in reducing carcinogenic airborne particulates.
- The foam may increase preservation of fire forensic evidence.
- Class A foam supports wildland/urban interface fire attack.
- Class A foam may provide long term financial savings and less severe property damage.
- The foam may help reduce stress and fatigue on firefighters operating during fire attack.
- Class A foam use can reduce overall on-scene time, returning companies back to service sooner.

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Strategies and Tactics

Class A foam is available and shall be used by fire companies for firefighting and exposure protection. Class A foam will be used during initial fire attack to assist with a quick knockdown of the base of fire. Class A foam will be used as needed to assist with overhaul in order to provide water penetration into deep seated and smoldering fire. Class A foam shall always be considered when fighting outside fires consuming natural vegetation or any woodland/urban interface. Class A foam will also provide an extra layer of protection when operating to protect exposures.

The following proportioning rates are to be considered when adding Class A Foam to an operating hose line:

- Initial Fire Attack: 0.3 - 0.5%
- Overhaul: 0.2 – 0.3%
- Fire Brake with wildland fire: 0.75%
- Exposure Protection: 1.0%

These proportioning rates are the typical rates as proposed by Mitch Hubert in *Fire & Rescue,* Second Quarter 2015, page 20.

Training

Class A foam training shall take place annually at one of the GFD's semi-annual Engineer refresher sessions. This will include training on the operation, maintenance, and trouble-shooting of the on-board foam proportioning systems. Each engineer will demonstrate proficiency with their respective pump and foam system.

Engineer promotional processes shall include written test questions on Class A foam advantages and use. Practical evolutions will also be conducted to test the proficient operation of the on-board foam proportioning systems.

Fire companies shall also train as needed on the uses and benefits of Class A foam as well as the operations of their companies' respective on-board foam proportioning system.