Preventing or Reducing Nashville Fire Department Personnel's Exposure to Carcinogens

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Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used language, ideas, expressions, or writings of another.

Signed: 

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Abstract

Cancer in firefighters has been linked to the toxic environments in which they work saving lives and property. Avoidance and the reduction of carcinogens have been proven to be effective in reducing the probability of contracting various cancers. The problem was the Nashville Fire Department (NFD) had neither identified nor implemented best practice standards in regards to preventing and reducing personnel's exposure to carcinogens. The purpose of this Applied Research Project (ARP) was to identify, develop, and implement best practice standards in order to prevent and reduce NFD personnel's exposure to carcinogens. The following research questions were addressed using the action research method: a) What are the most common ways NFD personnel are exposed to carcinogens? b) What are the NFD's current practices for minimizing the cancer risks among its personnel? c) To what degree do employees within the NFD recognize and comprehend the threat posed to their health from carcinogens? d) What guidelines and procedures have other fire departments across the nation implemented to minimize exposure of their personnel to carcinogens? A literature review, policy research, personal observations, and three independent surveys were conducted. A policy was drafted that addressed best practice standards for carcinogen avoidance and reduction. It was further recommended that training accompany the policy and be strictly enforced. Periodic research should be conducted to keep the policy current. Lastly, it was recommended that the NFD conduct a study of its diesel exhaust problem both in stations and at hospital receiving areas.

Table of Contents

Page

Certification……..2

Abstract……..…3

Table of Contents……..4

Introduction……...6

Background and Significance……...7

Literature Review……12

Procedures……26

Results……..31

Discussion……46

Recommendations……54

References……58

Appendix A: Personal Observation Data Form…….……..65

Appendix B: Suppression Section Questionnaire..…..……66

Appendix C: EMS Section Questionnaire…….…….……..73

Appendix D: Outside Fire Department Officers Questionnaire….……..80

Appendix E: Personal Observation Data Form …….……..83

Appendix F: OPG Draft…….……..84

Page

List of Figures

Figure 1. Responses to the performance of on-scene gross contamination……..…..35

Figure 2. Respondents who smell smoke while showering after working fire scenes...37

Figure 3. Respondents' level of concern about past practices leading to cancer……...41

Figure 4. Responses of departments that conduct on-scene gross decontamination.....44

List of Tables

Table 1. Hospital receiving areas diesel exhaust fumes rating……..32

Table 2. Top eleven issues members want to be addressed in a carcinogen OPG…….40

Preventing or Reducing Nashville Fire Department Personnel's Exposure to Carcinogens

Firefighter safety is a complex issue, and one topic that is being discussed in great detail is that of cancer prevention. The current consensus is that in order to prevent cancer, firefighters need to avoid or reduce their exposure to carcinogens, which are substances that are capable of causing cancer. A large portion of this problem can be classified as hygienic in nature. The very act of fighting fire is one that will expose firefighters to carcinogens and other toxins; therefore, firefighter protective gear should be decontaminated as soon as possible. Finally, what is considered safe today, may become obsolete tomorrow as new information is discovered on the topic of safety. It is up to the officers in any fire organization to remain diligent in the pursuit of continuing education that leads to constant discovery, in order to make our firefighters safer every day.

Although avoidance and reduction seems simple, it has proven to be anything but. Firefighters have to work in toxic environments that include smoke and gasses released from the burning of synthetic materials found in just about everything that is being produced to build and furnish homes, offices, and other types of buildings today. Advancements in firefighter protective ensembles have helped, although they are also hurting as they allow firefighters to stay in these hazardous atmospheres longer. The fabrics in firefighter's protective gear are becoming saturated with toxic carcinogens, allowing them to be transported back to the fire station or other unwanted locations.

The IAFF recently retweeted, "It's the little things, like keeping fire gear out of living quarters at the fire station that make a difference in occupational cancer prevention for fire fighters" (IAFF, 2018). This quote was actually a tweet from an Ohio Fire Fighters group that

has been retweeted multiple times as the discussion continues to grow to promote occupational cancer prevention in the fire service.

Firefighters must become more aware of the dangers these carcinogens pose to their health and understand that limiting exposure is vital. Unfortunately, many professions view getting dirty as part of the job. In some professions being dirty is a badge of honor, from the baseball player with dirt stains from sliding to steal that next base, to the way Hollywood portrays mechanics with grease smudges on their faces, to the firefighter wearing a half burned, soot-covered helmet with curled Bourke eye protection. In many professions, getting dirty means getting the job done.

The problem is the Nashville Fire Department has neither identified nor implemented best practice standards in regards to preventing and reducing personnel's exposure to carcinogens. The purpose of this Applied Research Project (ARP) is to identify, develop, and implement best practice standards in order to prevent and reduce NFD personnel's exposure to carcinogens. The following research questions will be addressed using the action research method: a) What are the most common ways NFD personnel are exposed to carcinogens? b) What are the NFD's current practices for minimizing the cancer risks among its personnel? c) To what degree do employees within the NFD recognize and comprehend the threat posed to their health from carcinogens? d) What guidelines and procedures have other fire departments across the nation implemented to minimize exposure of their personnel to carcinogens?

Background and Significance

The Nashville Fire Department (NFD) is a medium-to-large sized paid department with 1,253 salaried positions, with a 2017-2018 budget of $128,610,900 (Nashville.gov, 2017). The bulk of these positions are assigned to the Operations Division's two sections: the Suppression

Services, with 732 assigned and the Emergency Medical Services, with 325 assigned. The remaining assigned positions are currently occupied by 58 new suppression recruits and 138 Support Division positions that staff the training academy, special operations, logistics, maintenance, prevention, fire investigators, and administrative sections. The primary focus of this ARP was limited to the Operations Division plus 34 of the 58 new suppression recruits due to their probability of exposure to carcinogens.

The NFD is an all-hazards metropolitan fire department that serves not only the city of Nashville, Tennessee but the entirety of Davidson County's 526 square miles. The estimated total population of Davidson County is 643,771 with a substantial increase on weekdays with commuters and tourist (United States Census Bureau, 2015). The NFD serves the city of Nashville with 39 fire stations containing 39 engine companies, 12 truck companies, 4 heavy rescue companies and 28 staffed Advanced Life Support Ambulances. Suppression employees work 24-hour shifts 24/48, while EMS employees work 12-hour shifts, two 12-hour AM shifts, two 12-hour PM shifts, and four days off.

The NFD made some changes in 2017, one of them was creating three Incident Safety Chief positions. This allowed each of the NFD's three twenty-four hour shifts, A, B, and C, to have a dedicated incident safety officer (ISO). The ISO responds on the initial alarm to every structure fire in the county. Shortly after creating the position of ISO, the chief of the NFD decided to invest in the position by offering ninety class seats to be certified as an ISO through the Tennessee State Fire Commission. The three ISO chiefs upon completion of the ISO course delivered by the Tennessee Fire Service and Codes Enforcement Academy (TFACA) then taught the one week ISO certification class through a joint Co-op with the TFACA and the Nashville Fire Training Academy. The class was delivered in five different offerings of eighteen seats per

offering to suppression district chiefs, and the remaining seats would go to captains who could ride out of class when the ISO is off duty.

During the class, several national best practice safety standards were discussed. The TFACA instructor did an excellent job of facilitating discussions that allowed many strengths and weaknesses in the NFD's current Operational Procedures and Guidelines (OPGs) to be discovered. Ideas on how to improve NFD policies, training, and procedures for several safety issues such as MAYDAY, Rapid Intervention Teams (RIT), and Rehabilitation are examples of these classroom discussions. After a discussion about fire contaminates and wearing SCBA during overhaul, one of our district chiefs, a cancer survivor, made a comment of the fact that the NFD did not even have a policy addressing carcinogens or cancer. He went on to discuss how firefighters take their mask off way too early and he was certain that diesel exhaust was a problem our department was not addressing as new stations are being built without exhaust source capture systems.

About the same time period of these classes taking place, summer and fall of 2017, it seemed that members of the NFD were attending numerous funerals for retired firefighters who had succumbed to cancer. During preliminary research, it was discovered that cancer was a growing topic in the fire service. The NFD had no one keeping up with current best practice safety standards for cancer prevention, on-scene decontamination, or any other carcinogen reduction strategy. Baby wipes had been tried by the ISOs, but for the most part, they were rejected by firefighters.

While asking one of the risk management officers about a cancer prevention policy, it was discovered that he had been tracking reported cases of cancer since 2000. The data tracking he used was voluntary, and the information came via cancer claims. Unless a family member

brought proof that a retiree had died due to cancer, their name was not in the data registry. Officially, there have been 155 reported cases of cancer diagnosed to NFD personnel since 2000. Unofficially, the actual number of cases of cancer remain unknown. Retirees move away from the area and their surviving family never reports the details back to the department. Others may not even think to report the information to the department because they did not know anyone was tracking cancer data, or that their cancer was an occupationally related illness in which the department was responsible for the medical cost.

The EMS section was included in this ARP's scope of research because as an ISO, the researcher also noticed that they were getting exposed to carcinogens. Sometimes they may not even be cognizant of the dangers of how they have been exposed by simply trying to care for injured, tired, or overheated firefighters. This became apparent when visiting a hospital emergency department (ED) after a fire in which a firefighter was transported from the scene with smoke inhalation after his mask was dislodged from his face while performing a primary search. Walking down the hallway to the treatment room where the firefighter was being treated, the ISO noticed a familiar smell. It was the smell a firefighter smells before arriving on the scene of a working fire and knows it is going to be a tough one.

Upon turning the corner and entering the treatment room while seeing the firefighter in good condition, the ISO's thoughts shifted to the obvious exposure of Volatile Organic Compounds (VOCs), carcinogens, and other toxins, to the EMS crew who transported, the ED staff who were caring for the firefighter, as well as the firefighter, himself, still wearing contaminated turnout gear and still being exposed. To be clear, the NFD has an Operational Procedure and Guideline (OPG) addressing decontaminating patients prior to transport, but that OPG refers to hazardous materials operations. The NFD needs to better define contamination

and decontamination to see if a differentiation exists between hazardous material incidents and structure fire incidents when addressing acceptable exposures within its risk profile.

In one of many discussions with the Executive Analysis of Community Risk Reduction Training Specialist, Mary Marchone, she coined the phrase “We don’t know what we don’t know.” Although this phrase may sound peculiar, it offers a platform that firefighters should adopt when thoroughly studying problems, identifying contributing factors, and seeking solutions. Fire service leaders and firefighters within the NFD, and across the nation, have to educate themselves and work collaboratively in order to overcome the problems they know and have identified, as well as the unknowns they have yet to discover.

There is a definitive link between this ARP and the researcher’s Executive Fire Officer Program (EFOP) course, Executive Leadership (EL). Executive Fire Officers are the leaders within their organization, and as such, one of their most important tasks is ensuring the safety of their personnel through current and best practice standard hazard prevention and mitigation. To achieve this goal, the EFO will have to research and apply adaptive leadership to bridge the gap between the *status quo* and the goal of a more safety conscious department. This ARP by its very nature exposes issues requiring transformational leadership in order to change behaviors and attitudes throughout NFD’s personnel as well as upper leadership.

There is a distinct correlation between this ARP and the USFA operational goals, “Reduce risk at the local level through prevention and mitigation” and “Improve the fire and emergency services’ capabilities for response to and recovery from all hazards” (USFA, 2009). These goals are achieved by evaluating and establishing policy to reduce the risk and mitigate the exposure of carcinogens of NFD personnel and subsequent cross-contamination that may occur to the public they serve. This level of research further aligns with the USFA operational

goals of “Improving the fire and emergency services’ professional status” and to “Lead the Nation’s fire and emergency services by establishing and sustaining USFA as a dynamic organization” (USFA, 2009) by promoting firefighter safety and health within the researcher’s organization.

Literature Review

A literature review was conducted to establish a comprehensive overview of the problem of carcinogen exposure to firefighters. In order to understand the problem associated with exposure to carcinogens, those posing the greatest threats to firefighters are identified and discussed. The prevalence of increased carcinogen levels in modern fires and the most common routes of exposure are discussed. Studies associating the relative risk of cancer with the occupation of firefighting were explored. Personal protective equipment (PPE), its effectiveness, and associated problems are examined. Lastly, best practice standards, engineering, education, and regulations to mitigate and reduce firefighter exposure to carcinogens are identified and discussed.

The foremost problem with exposure to carcinogens is that they are known to be cancer-causing. The American Cancer Society defines carcinogens as “substances and exposures that can lead to cancer” (ACS, 2016). It then explains that the mechanism of action can either be the direct altering of DNA or that “they may cause cells to divide at a faster than normal rate, which could increase the chances that DNA changes will occur” (ACS, 2016). No one can definitively define the latency period. There is uncertainty in understanding how long it takes to contract cancer once exposed to carcinogens, as well as quantities of the materials that definitively cause cancer. Kacee Deener explains in her article that a long-held truth in the school of toxicology was, “the dose makes the poison”. This was first articulated by Paracelsus, a 16th century

German-Swiss Physician, whose idea is being challenged by modern science. She further explains that when considering dose versus effect, the lifetime of an exposure to a substance must be considered (Deener, 2014). The American Cancer Society admits that while it is known that certain substances and exposures can cause cells to change, possibly leading to cancer, the exact science or nature of how and why the process leads to cancer is not yet known (ACS, 2018).

A surgeon by the name of Percivall Pott made history in 1775 by giving rise to the field of occupational exposure when he observed and recorded his findings. Pott astutely connected the occupation of chimney sweeps and their prolonged exposure to soot with cancer of the scrotum, an insight that lead him to not only offer preventative remedies but also to seek action to protect the youth who were associated with the occupation (Herr, 2011). This citing of occupational cancer and the suggested finding led to changes in the industry such as the age one could seek to work as a sweep. Other regulations, as well as numerous improvements in hygiene, decreased the problem of chimney sweeps scrotum cancer throughout the 1800s and early 1900s to only one case noted out of 5,000 at St. Bartholomew's Hospital, London (Brown & Thornton, 1957).

Soot is one of many known carcinogens that firefighters are exposed to. It is the black smudge marks present on firefighters' faces and necks after a fire that is killing firefighters, often portrayed with makeup in firefighter calendars to make the firefighter look more rugged. Soot is actually a chemical compound caused by incomplete combustion that has been found to contain many known and suspected carcinogens including but not limited to, "arsenic, cadmium, chromium, nickel, and several polycyclic aromatic hydrocarbons (PAHs), including benz[*a*]anthracene, benzo[*a*]pyrene, dibenz[*a,h*]anthracene, and indeno[1,2,3-*cd*]pyrene"

(National Toxicology Program, 2016). It was noted that soot may contain different compounds based upon the incomplete combustion of organic materials such as plastics, woods, fuel oils or other carbon-containing materials and that these compounds and chemicals may have other toxic effects to the human body in addition to being known or suspected carcinogens (IARC, 2010).

Many of these substances and compounds are used to manufacture synthetics, plastics, adhesives, pigments, and even flame retardants such as polybrominated biphenyls (PBBs) that are found in modern building materials and furnishings. These materials are found in smoke produced during the combustion process. In *The Atlantic,* an article about the dangers of modern furnishings to firefighters, Virginia Weaver, a professor at Johns Hopkins University, explained, "the more synthetics there are in a home, the more chemicals are present in the smoke, and the more chemicals that are carcinogens" (Khazan, 2015). Smoke is comprised of both liquid and solid particulates, as well as gasses and vapors from the process of combustion and pyrolysis. These gasses, vapors, and particulates are chemicals, many of which are toxic and carcinogenic.

One carcinogenic occupational exposure that occurs both inside and outside the loop of an emergency response is diesel exhaust. Debra Silverman states in her article, "After three decades of epidemiologic research, diesel exhaust was classified as a carcinogen in humans by the International Agency for Research on Cancer (IARC) in 2012 based on evidence of its carcinogenicity to the lung" (Silverman, 2017). Diesel exhaust has been found to contain "diesel particulate matter (DPM), a component of diesel exhaust that includes soot particles made up primarily of carbon, ash, metallic abrasion particles, sulfates and silicates" (Avsec, 2017). The soot in diesel exhaust contains elemental carbon (EC) which is bound with other "organic compounds known as polycyclic aromatic hydrocarbons (PAHs)" (Avsec, 2017), which are similar to the soot compounds identified earlier.

The World Health Organization (WHO) and the International Agency for Research on Cancer (IARC) have compiled an exhaustive list of carcinogens divided into five groups:

> Group 1, Carcinogenic to humans 120 agents, Group 2A, Probably carcinogenic to humans 81 agents, Group 2B, Possibly carcinogenic to humans 299 agents, Group 3 Not classifiable as to its carcinogenicity to humans 502 agents, and Group 4 Probably not carcinogenic to humans 1 agent (IARC, 2018).

These chemical substances and compounds are not limited to one functional chemical group as they can be found in most organic and inorganic function groups. Some exist in elemental form, compounds, radioisotopes, ionizing radiation, volatile organic compounds (VOCs), and some are viruses (IARC, 2018). While the IARC list of carcinogens is certainly comprehensive, the Centers for Disease Control and Prevention (CDC) website in conjunction with the National Institute for Occupational Safety and Health (NIOSH) has produced a list of 131 carcinogenic substances and compounds that are potential occupational carcinogens (CDC, 2018).

Some of the more commonly known carcinogens that firefighters have a greater risk of exposure to in smoke have been identified as Arsenic, Asbestos, Benzene, Benzo[a]pyrene, 1,3-butadiene, Formaldehyde, Radioactivity (γ activity), Radionuclides (α and β-particles-emitting), Silica, Sulfuric acid, and 2,3,7,8-tetrachloro dibenzo-*para*-dioxin (IARC, 2010). According to Vincent Dunn, it should be noted that “Combustion products given off from a smoldering fire are more toxic and hazardous than flaming fire” (Dunn, 2018). Ironically, the cover photo for *Firehouse Magazine* from which Dunn’s statement came, show numerous firefighters at an actual fire scene operating with SCBA on their backs, but not wearing face pieces while breathing smoke (Gianos, 2018).

Several studies have examined firefighters to determine any associated risk with exposure to the carcinogens associated with firefighting. One published study, the LeMasters meta-analysis, pooled data from 32 smaller studies involving firefighters, and 21 different cancer diagnoses or types. Of the 21cancer types, 10 were identified as having a significantly increased relative risk as opposed to non-firefighters. These include Colon cancer, Stomach cancer, Prostate cancer, Rectum cancer, Brain cancer, Malignant melanoma, Skin cancer, Non-Hodgkin lymphoma, Multiple myeloma, and Testicular cancer (LeMasters et al., 2006).

From the results, inferences can be made that firefighters have a significantly higher risk of getting cancer as a result of their increased exposure to known carcinogens. However, the LeMasters study did not include factors such as lifestyle, outside work exposures, previous medical history, or hereditary factors.

Another study examining cancer risks associated with firefighting was the NIOSH study. Nearly 30,000 firefighters from fire departments in Chicago, Philadelphia, and San Francisco participated. The study included all personnel who had worked as a firefighter from 1950 to 2009, even if for only one day. The study examined exposures in terms of days worked for all three departments, fire calls made by firefighters from Chicago and Philadelphia Fire Departments, and total hours at fire scenes by firefighters from Chicago. Comparisons were made between the three different exposure groups to that of the general U.S. and State populations. Study limitations included few women and minorities participated, exposure type and quantity was not assessed, as well as unknowns in previous medical history, heredity, or lifestyle factors (CDC, 2016).

The NIOSH study concluded that the overall cancer mortality of the firefighters studied was 1.14 times greater than the U.S. population. Furthermore, the incidence of cancer of the

firefighters studied was 1.09 times greater than the U.S. population (Daniels et al., 2014). Additional findings in the study suggested other firefighters' cancer types, which had increased relative risk between 1.01 to 1.49 times greater, included, stomach, intestine large and small, rectum, lung, breast, prostate, kidney, bladder, and, buccal and pharynx (Daniels et al., 2014). Two types of cancer with significant increases, in firefighters that had an increase in relative risk, were esophageal cancer 1.62 times greater and Mesothelioma 2.29 times greater (Daniels et al., 2014). The study identifies the need for a national cancer registry, as the methods used were limited geographically and it is impossible to know how many incidents and incident mortalities were missed (Daniels et al., 2014).

Another study, identified as the Nordic study, compiled census data from five Nordic countries comprising 15 million people and data from their cancer registries from 1961 to 2005. The information was compared with data from a cohort of 16,422 male firefighters in order to assess the risk of occupational exposure to carcinogens during firefighting (Pukkala et al., 2014). Limitations included unknown medical history, heredity, or any women being included. This is because only a small number of women serve in the fire service of these Nordic countries.

The Nordic study showed an overall increased cancer risk 1.06 times greater than the general Nordic population (Pukkala et al., 2014). The study showed Nordic firefighters had an increase in relative risk 1.01 to 1.49 times greater for the following cancer types: tongue, stomach, small intestine, colon, gallbladder, pancreas, larynx, adenocarcinoma, skin melanoma, soft-tissue, prostate, bladder, thyroid, Non-Hodgkin lymphoma, multiple myeloma, acute myeloid, and non-melanoma skin cancer (Pukkala et al., 2014). Cancers that had an increased relative risk higher than 1.50 times greater were, Salivary glands 1.69 times greater, Mesothelioma 1.55 times greater, and Penis 1.53 times greater than the general Nordic

population (Pukkala et al., 2014). The study also mentions the possibility of PAHs and diesel exhaust possibly being linked to prostate cancer. It found that prostate cancer was seen in their cohort earlier than usual with firefighters age 30 to 49 found to have a relative risk of 2.59 times greater than the general public in Nordic countries. This information may call for earlier prostate-specific antigen (PSA) screenings than the age of 50 (Pukkala et al., 2014).

Two other studies regarding firefighter cancer relative risks are the IARC Monographs volume 98, which concluded, "There is *limited evidence* in humans for the carcinogenicity of occupational exposure as a firefighter" and that, "Occupational exposure as a firefighter is *possibly carcinogenic to humans (Group 2B)*" (IARC, 2010). The last study to be mentioned was the Monash University, Australian Firefighters Health Study. Monash University was commissioned in 2011 by the Australian Fire and Emergency Service Authorities Council to study mortality and cancer incidents in Australian as compared to the Australian population. The study cohort was comprised of 17,394 career firefighters, 12,663 part-time firefighters, and 37,973 volunteer firefighters. The more notable findings were significantly increased relative risk for career, part-time, and volunteer firefighters developing prostate cancer and melanoma (Glass et al., 2014). Both prostate cancer and melanoma can be treated with early detection through appropriate screening.

The routes of exposure for carcinogens are the same as any other chemical exposure. They include penetration, ingestion, inhalation, and absorption. Although rare, penetration is possible and would most likely involve a sharp object breaking the skin and transporting carcinogens into the body. Inhalation occurs when carcinogens are breathed in while ingestion would involve taking them into the mouth. Absorption involves a dermal exposure where carcinogens enter the body through the skin.

To combat the problem of carcinogen exposure during fires, firefighters have personal protective gear (PPE) comprised of helmets, eye protection devices, hoods, coats, trousers, gloves, footwear, and self-contained breathing apparatus (SCBA). One of the more popular training manuals used to train new firefighters, *IFSTA Essentials of Fire Fighting,* has a specific chapter dedicated solely to PPE instruction in proper fit, donning and doffing, when to wear it, and proper maintenance. IFSTA is clear on ensuring new firefighters know that proper PPE, including SCBA, is required any time a firefighter enters an immediately dangerous to life and health (IDLH) atmosphere (IFSTA, 2013).

Firefighters are taught as recruits that if they wear their PPE they are protected. However, new studies are showing that while firefighters are protected from heat and flames, PPE does not adequately protect against exposure to carcinogens. Mark Dolim explains that while advancements in protection allow firefighters to go deeper and stay longer in structure fires, the human body remains a constant that must be considered (Dolim, 2014). This ability to stay longer in atmospheres where smoke is thick and pressurized means firefighters are receiving a significant exposure to the chemicals present. Unfortunately, firefighter PPE for structure fires is not designed to be chemical protective clothing. In one investigative news report, it was reported that soot can seep into gaps in firefighter PPE around the face, neck, hands, and legs. It further reported these carcinogens are then able to be absorbed through the skin, and that "with every five-degree rise in skin temperature, absorption goes up by 400 percent" (Lyden, 2017).

In a study funded by NIOSH, firefighters were tested for systemic exposure to PAHs and benzene after extinguishing controlled structure fires. Full PPE including SCBA was worn during both extinguishment and overhaul. SCBA was not removed until firefighters were greater than thirty meters up-wind of the control burn structure. The analysis included dermal wipes

pre- and post-fire extinguishment, exhaled breath samples collected pre, post, and six hours post-fire extinguishment, and urine samples collected pre, post, three and six hours post-fire extinguishment. The results suggested skin in the area of the neck was the most contaminated. The breath samples showed only slight benzene levels comparable to other low exposed employee occupations. Finally, results showed that PAHs most likely enter firefighters through dermal exposure, though researchers could not rule out the possibility of some PAHs being inhaled during doffing of gear that was saturated in contaminants that may still have been off-gassing (Fent et al., 2014).

In a related study by the University of Ottawa, results showed that PAHs had breached the firefighters' PPE and was absorbed through their skin. Research team leader Jennifer Keir and her team reached these findings, "based on urine samples and skin swabs from Ottawa firefighters between January 2015 and April 2016, suggest that a major pathway for those toxins is through the skin" (Payne, 2017). According to Weber, these samples were obtained from the firefighters at the start of their shift to achieve a known baseline. Later, if the firefighters responded to a fire, they would have post incident samples taken. Blais, who obtained the post-fire samples from the firefighters via urine and skin swabs, reported high levels of PAHs (Weber, 2017).

Offering a different perspective in studying carcinogen exposure routes to firefighters, the dermal exposure, as well as the level of residual contamination remaining on firefighters PPE was studied. In one portion of the study, six sets of firefighters' post-overhaul exposed PPE were placed in an enclosed area the size of a fire apparatus cab to simulate contaminated gear in the cab on the ride back to a fire hall. Findings suggested that while VOCs measured lower than Occupational Safety and Health Administration (OSHA) short-term exposure limits (STEL),

firefighters could be exposed to numerous chemicals via inhalation during the ride back to their station. The report also suggested that while VOCs evaporate from PPE due to their volatile vapor pressures, soot and PAHs have to be removed through decontamination efforts. Additionally, it was found that each exposure increases the contamination level of firefighters PPE and was relational to exposure due to job assignment. Finally, the study concluded soap and water decontamination techniques work best in removing PAH contamination and the VOC off-gas levels studied reached below OSHA's STEL within twenty-four minutes (Fent et al., 2017).

Understanding the problem of how firefighters are exposed to carcinogens has helped fire service leaders and industry leaders push for change. In an International Association of Fire Fighters (IAFF) Cancer Summit, IAFF General President Schaitberger delivered the summit's welcome and opening remarks. Some of the prevention efforts President Schaitberger spoke of involved changing the image of firefighters from those of firefighters being soot-covered and smoking cigarettes. He then reminded those in attendance of the health, nutrition, and physical fitness initiatives of which the IAFF has been involved. He spoke of the importance of wearing proper gear, decontaminating at the scene, and washing the body after fires. He elaborated on the importance of cleaning gear using extractors and fire departments offering its members two sets of gear. Other measures visited included presumptive legislation, National Fire Incident Reporting System (NFIRS) reporting, documenting exposures, and getting Congress to create and pass legislation for a National Cancer Registry (Schaitberger, 2018).

When Boston firefighter Glenn Preston received the news that he had cancer, Miller in an article reports, "The news was devastating, but it wasn't exactly a shock. 'I'm a fireman.' Preston says matter-of-factly. 'I had a feeling that it would happen. But not when I was 39'" (Miller, 2017). In the same article, the wife of a Chelsea firefighter morns the loss of her

husband to cancer in 2016, stating “wearing your mask is still not considered cool” (Miller, 2017). A textbook on firefighter safety explains that carcinogens cause cancer then rhetorically question “how often do you see firefighters breathing smoke during overhaul?” (Dodson, 2016). The reoccurring problem of not wearing gear at every fire, including overhaul, is unacceptable and can be observed as a poor attitude concerning safety. Chief Travis Ford of the NFD writes “Accountability is the action needed that makes the difference in getting the right results for creating the cultural change needed to become more safety conscious” (Ford, 2017).

When firefighter PPE is worn correctly on every fire incident, exposures to carcinogens will be reduced, but not eliminated. The next most obvious step would be to train firefighters how to properly decontaminate their PPE, doff their PPE in a manner reducing further exposure, and how to transport, clean, and store PPE in a manner that does not cause cross contamination. In a recent magazine article discussing the toxic-rich environment present post fires, the authors offer further advice, in addition to wearing PPE with SCBA. They recommend fire departments limiting crews’ exposure times in the IDLH environment to limit the “dose”, performance of gross decontamination, as well as “changing clothes and showering post incident” (Clark & Hadaway, 2017). In addition to decontaminating PPE, another online article, referred to as the *White Paper*, addresses the need to decontaminate the interior of fire apparatus as well as keeping bunker gear out of living quarters at fire stations (Firefighter Cancer Support Network, 2013).

Redundant articles continue explaining best practice standards for post-fire incidents. In Firehouse Magazine, Matthew Vinci said to wear SCBA throughout the duration of all firefighting activities, then decontaminate PPE with soap and water. Next, firefighters are advised to clean exposed skin with wipes, or soap and water. Vinci then recommends bagging

PPE at the scene, placing it in an external compartment for the trip back to the station, then have all PPE laundered including gloves and hoods (Vinci, 2017). In another article, the effectiveness of soap and water decontamination was said to be "the most effective as it decreased contamination by 85 percent" (Jahnke, 2017). The majority of what is being said concerning the wearing and cleaning of PPE is not new, as this information can be found in National Fire Protection Association (NFPA) Standards.

It is important for fire service leaders to conduct research to educate themselves on what they do not know. One way to accomplish this task is through education, another is to reach out to the academic world for help. In an article written by Chief Greg Mackin of the Boston Fire Department, he explains that the BFD has done just that. He went on to say that they "reached out to world-leading academics and researchers to fully understand the challenges faced by firefighters" (Mackin, 2016). Fire and emergency service leaders should seek out education that allows them to have a better understanding of scholarly research in order to help identify problems and develop solutions.

Further advancements are being made in firefighter PPE to help protect against carcinogen exposure. Because research has shown the hood is one of the weakest points in firefighter PPE, one particular article discusses the evolution of newer hoods that utilize moisture barriers to block contaminants. Other hoods discussed, used layers to filter particles rather than just blocking them. The article cautions that new hoods may reduce hearing and reminds readers that "barrier hoods are an important first step, but not the silver bullet for cancer prevention" (Stull & Stull, 2016).

To help firefighters combat the dangers of diesel exhaust in fire stations, some departments such as the San Antonio Fire Department are offering safety precautions in the form

of Standard Operating Procedures (SOPs). The SOP covers ideas such as when fire apparatus needs to idle, the apparatus needs to be out of the building. Furthermore, the apparatus should not be started until all bay doors are open (Hood, 2015). Although SOPs are a good way to protect firefighters, another is through engineering. One example of this engineering is a diesel exhaust source capture system. These systems remove diesel exhaust from apparatus bay areas via ducts and fans that pull exhaust from the apparatus exhaust pipe, then redirecting the harmful contaminants and carcinogens outdoors. Chief Avsec explains in his article how NFPA standard 1500 recommends that fire departments contain all vehicle exhaust, just as source capture systems do. (Avsec, 2017).

Moving beyond NFPA consensus standards, department policies, and procedures, the next step forward would be regulations. In the investigative journalism report *Fatal Echoes*, the authors discuss how regulations such as those drafted by OSHA could aide in saving firefighters' lives. The problem, however, is that government workers, both state and local, may not fall under Federal OSHA regulations. If they do, however, as in the case of OSHA funded states, enforcement varies among the different OSHA states (Hendricks & Campbell, 2016).

Many states offer presumptive legislation to help protect firefighters once a diagnosis of cancer has been made. Tennessee is one such state. While presumptive legislation is good, and it eliminates the employee's burden of proof that the illness being considered is occupational, it may not be as easy as it seems. In the case of Spivey v. City of Bellevue, Delmis Spivey had to appeal his case all the way to the Washington State Supreme Court in order to seek restitution. Spivey won his case to include attorney fees (Varone, 2017). Other legislation being considered is House bill, H.R. 931. This bill would create a voluntary national cancer registry that assists in tracking the true impact of cancer on the fire service to aid in future studies.

A look at other fire departments policies was included in this literature review in order to ascertain how outside fire departments are addressing carcinogen exposures. One department addresses on scene gross decontamination as water only from a booster prior to the removal of any PPE to include face pieces if air reserves permit (Westminster Fire-Rescue, 2016). Another department policy was found regarding fire ground safety. In this SOP, incident commanders are charged with limiting the personnel on the fire ground by assignments and functions. Additionally, hazard control zones are to be established on fire scenes with full PPE including SCBA being required when inside the hot zone (Phoenix Regional, 1999).

In addition to policies, the researcher looked at two ARPs written on the subject of carcinogen exposure reduction or prevention. In his recommendations section, Brinker noted the need for policy, on-scene gross decontamination, personal decontamination, reducing cross-contamination due to dirty bunker gear, laundering station uniforms at in the fire station not at home, stricter policy enforcement of SCBA usage, two sets of turnouts per member, annual health screenings, and the conduction of further research into the use of infrared saunas (Brinker, 2017). Sixteen years prior to Brinker's ARP, another ARP written by White noted that carcinogen reduction should be addressed in policy, and such policy should be trained to department members. Furthermore, White found carcinogen exposure can be reduced by use of SCBA, decontamination, regular cleaning of PPE to remove accumulated contaminants, keeping PPE out of living quarters, station uniforms should be laundered at the station not at home, and vehicles should use the *Plymovent* exhaust removal system in station bays. Finally, White suggested reporting violations of the proposed cancer prevention policy, and that periodic review should occur to ensure that the policy stays current (White, 2001).

The fire service has to do a better job of collaborating and disseminating all vital information. In a monthly newsletter, Chief Sinclair discussed how baby wipes would soon be on all fire apparatus' for personal decontamination of the face, neck, other areas where contaminants are located (Sinclair, 2013). Four years later, when three new safety chief positions opened up in March 2017 within the Nashville Fire Department, a considerable amount of effort was given in offering baby wipes for personal decontamination. This idea was met with mixed responses, most notably those of conjecture and contempt. Justifiably, there needs to be more coordination of training and education not only in the NFD but within the American Fire Service, especially when health and safety issues are involved.

In conclusion, a review of the literature was conducted to evaluate the problem of carcinogen exposure to firefighters. The carcinogens posing the greatest threats to firefighters have been defined and identified as allowed by the current understanding of available science. The prevalence of more carcinogens in modern fires and the routes of exposure have been noted. Studies associating the relative risk of cancer with occupational exposures of firefighting were explored. Personal protective equipment (PPE), effectiveness, and the associated problems have been examined. Finally, best practice standards, engineering, education, and regulation to mitigate and further reduce firefighter exposure to carcinogens have been recognized and examined. There can be no definite conclusion in subjects relating to firefighter safety. In this profession, one must stay vigilant in the pursuit of knowledge to promote and perpetuate the gravity of firefighter safety.

Procedures

The purpose of this Applied Research Project (ARP) was to identify, develop, and implement best practice standards in order to prevent and reduce NFD personnel's exposure to

carcinogens. The action research method was chosen because the researcher's department did not have a policy in place to address the prevention and reduction of carcinogen exposure for NFD personnel. The research was comprised of a literature review as well as reviewing existing NFD Operational Procedures and Guidelines (OPGs) to identify policies that may already partially address carcinogen prevention and reduction. Personal observations were conducted in order to see how NFD personnel were being exposed to carcinogens. Three surveys were designed to assess to what degree NFD personnel recognized and comprehended the threat carcinogens posed to their health. Finally, other fire departments' policies were examined and a survey was conducted to identify how these departments address carcinogen exposure in terms of policy and procedure.

The first research question posed was, a) what are the most common ways NFD personnel are exposed to carcinogens? To answer this question, personal observations were made by myself and one other ISO over the period of one month. From the literature, all of the different ways firefighters can be exposed to carcinogens based on routes of exposure were listed and placed on a data collection form (see Appendix A). The exposure types, as well as whether the exposure happened during an emergency response or a non-emergency response, were listed in rows. This information was used to create two columns corresponding with the exposure type rows. The observer could then record exposures by placing tally marks on the data collection form and space was provided for remarks. The form included a place for the time, date, and address of the observation taken. This information allowed the observer to go into Rescue Bridge and see how many personnel were on the scene of each fire layout incident allowing for a comparison of the number of exposures observed to number present. The information from the

NFIRS report found in Rescue Bridge provided the total number of fire layouts, personnel committed, and total bottles used, as can be found recorded in appendix A.

In addition, two questionnaires were disseminated to all Operations Division employees via email using Google Forms as a platform in order to allow respondents to maintain anonymity. One questionnaire was designed for suppression employees (see Appendix B), and the second was designed for EMS employees (see Appendix C) based upon their individual job functions. Both questionnaires asked closed ended and forced choice questions designed to identify employees' exposures based on their answer choice.

The second research question was, b) what are the NFD's current practices for minimizing the cancer risks among its personnel? To answer this question, NFD Operational Procedures and Guidelines (OPGs) were reviewed to determine what if anything was already being addressed in order to eliminate or reduce exposures to carcinogens in existing policy. During the personal observation period, there was a space provided on the data collection form to document and describe any best practice standards to eliminate or reduce exposures to carcinogens that may have been conducted by NFD personnel in the absence of policy.

The third research question was, c) to what degree do employees within the NFD recognize and comprehend the threat posed to their health from carcinogens? To answer this research question, the Operations Division, suppression and EMS were asked forced choice and open-ended questions in their section questionnaires designed to solicit responses in order to determine the perceived level of recognition and comprehension to the threat carcinogens pose.

Finally, the fourth research question was, d) what guidelines and procedures have other fire departments across the nation implemented to minimize exposure of their personnel to carcinogens? To answer this question, all officers from other fire departments in the researcher's

four EFOP classes, as well as the EFO students and graduates in the online Facebook group NFA EFO 2014 to Present, which is a closed group containing 238 members, were asked to send any policies that their departments had that addressed elimination and reduction of carcinogen contamination. This same group of Fire officers was asked to participate in a questionnaire designed using Google Forms as the survey platform (see Appendix D). The questions were a combination of closed-ended and forced choice, with one open ended designed to explore options for creating best practice standards that could be applied in an OPG for NFD personnel. The same questionnaire was sent to the International Association of Fire Chiefs (IAFC) website for the EFO section using the EFO survey submission form to be open for two weeks.

A total of four questionnaires were created to assist in answering the research questions. The suppression section questionnaire was emailed to the entire suppression body of 732 employees. Because participation was voluntary and anonymous, the results were limited to a total of 202 respondents which is 52 shy of the recommended sample size outlined in figure 5 of the *Applied Research Self-Study Course Guide (Q0123).* The EMS section questionnaire was emailed to the entire EMS body of 325 employees. Again, as participation was voluntary and anonymous, the results were limited to a total of 90 respondents which is 85 shy of the recommended sample size outlined in figure 5 of the *Applied Research Self-Study Course Guide (Q0123).* The Outside Fire Departments Questionnaire was emailed to all members of the researcher's four EFOP classes, as well as the online Facebook group NFA EFO 2014 to Present, which is a closed group containing 238 members. The Outside Fire Departments questionnaire was also sent to the IAFC website EFO section in hopes of getting more responses. According to Dr. Clark, there are "32,000 fire departments in the United States of America" (2015). Participation to the outside fire departments questionnaire being voluntary and anonymous, the

results were limited to a total of 67 respondents which is about 310 shy of the recommended sample size outlined in figure 5 of the *Applied Research Self-Study Course Guide (Q0123)*.

Three questionnaires designed for the NFD's participation were submitted and approved by the current Deputy Chief of the Nashville Fire Department. However, the Chief Training Officer objected to the fire recruits being asked to complete a questionnaire, so the recruits did not participate in the questionnaire process. This limitation was overcome by the researcher conducting personal observations. These observations were recorded to a data collection form (see Appendix E) and were strictly the observations made by the researcher during visits to the academy at different times while on shift during the month of February 2018. Also, the researcher was able to observe and interact with these recruits during the first full week of March 2018, while teaching them Hazardous Materials Awareness and Operations.

The most disappointing limiting factor was the poor response to all surveys. Figure 5 of the *Applied Research Self-Study Course Guide (Q0123)* establishes population and sample size criteria in order to achieve a confidence level of 95%. The lack of participation was unexpected, as this ARP was the researcher's fourth, with previous participation usually satisfying the confidence level of 95%. All questions and answers were recorded and can be found in the previously mentioned appendices. However, only findings pertinent to the four research questions will be presented in the Results section. Due to a lack of policies sent to the researcher, policies and two EFO ARPs were also used to research outside fire departments best practices.

Finally, limiting factors included a late unexpected release of an OPG titled Carcinogen Exposure Reduction, OPG 1.53 (NFD, 2018). This OPG was released beyond the three-month mark of this research. Because the OPG was incomplete and void of procedures that had been

already discovered during research, the researcher continued this ARP as initially described in the ARP proposal. Further this research was being conducted under the knowledge and consent of the NFD's Deputy Fire Chief.

Results

In the results section, the research questions will be restated and the results from the research will follow. The research questions will be addressed with any pertinent information from the research as described in the Procedures section. All raw research data results are provided in the appendices section of this ARP as identified in the previous section. The purpose of the question and answer format is to keep the reader focused on one research question at a time.

The first research question, a) what are the most common ways NFD personnel are exposed to carcinogens, was answered by two questionnaires and personal observations. In order to establish the most common ways NFD personnel were exposed to carcinogens, they were asked questions about their own personal practices, both on scene, as well, as in station. These practices can determine if the employee was possibly exposed by one of the three most common routes of exposure: inhalation, ingestion, and dermal.

To discover occurrences of inhalation exposures to EMS members, they were asked if they had ever staged or worked on a fire scene in an area where they had possibly breathed smoke as a result of wind changes or temperature inversions. Of the 90 respondents 85 or 95.5% said yes, they had breathed smoke. The EMS members were asked if they had transported firefighters from a fire scene who were wearing their bunker gear. Of the 90 respondents 62 or 68.9% said that they had transported firefighters in turnout gear, with 28 or 31.1% answering no.

It had been observed by the researcher that patient receiving areas or bays at Nashville area hospitals are often congested with diesel fumes from multiple ambulances of different ages idling (some on high idle) in these compact areas. Although outdoors, some of these areas are enclosed, with walls or half-walls on three sides and a canopy overhead. EMS employees were asked if they thought the air around hospital emergency department (ED) receiving areas was safe to breath. Of the 90 respondents 62 or 69.7%, answered no, 27 or 30.3% answered yes and one chose not to answer. The EMS employees were asked to rate the hospital receiving areas on a Likert Scale one through five, with five representing the highest perceived level of fumes in the receiving area. The two receiving areas with the highest perceived fumes were Vanderbilt University Medical Center and Vanderbilt Children's Hospital in their ambulance receiving areas. These two hospital receiving areas are the most confined, but they do have soot covered portable fans that blow exhaust away from the ED's entry doors. Below is a table showing the perceived results from the nine area hospital's receiving areas, one can almost compare the results to the actual level of confinement or the areas by walls and canopies (see Table 1).

Table 1
Hospital receiving areas rating diesel exhaust fumes 1 through 5, 5 is the highest perceived.

Rating 1-5	1	2	3	4	5
Vanderbilt Med. Ctr.	5	18	22	21	24
Vanderbilt Children's	5	14	21	22	28
Skyline Hospital	11	33	24	14	8
Centennial Hospital	12	26	25	21	6
Veterans Hospital	19	31	23	12	5
Southern Hills	12	36	29	10	3
St. Thomas Midtown	12	24	24	21	9
St. Thomas West	14	28	30	14	4
Summit Hospital	19	34	27	6	4

Note. Numbers represent respondent's choices made corresponding to each hospital.

The NFD does not have a single station with exhaust source capturing systems. Currently, six of the NFD's stations have only front bay doors requiring apparatus to be backed

into the bay. Additionally, ten other stations have equipment that runs out of the front and back requiring apparatus to be backed into the bays at these stations. EMS members were asked if they ensured everyone was onboard the ambulance prior to starting the engine. Of the 90 respondents 35 or 38.9% answered yes while 55 or 61.1% answered no, indicating they started the engine prior to everyone getting onboard.

Similarly, suppression members were asked if the engineer waited until everyone was onboard prior to starting the engine. Of the 202 respondents, 53 or 26.2% answered yes while 149 or 73.8% answered no indicating the engineer did not wait until everyone was onboard to start the engine. Suppression members were also asked if there was fire apparatus running in the bay in the mornings while the engineer or acting engineer was checking off the apparatus. Of the 202 suppression respondents, 110 or 54.5% answered yes, that apparatus runs in the station bay during morning equipment check offs, with 92 or 45.5% answering no. Interestingly, when asked if they understood the dangers of diesel exhaust, 175 or 86.6% of suppression members answered yes, while the other 27 or 13.4% of 202 respondents answered no.

Asking a more direct question in regards to inhalation exposures of carcinogens, fire suppression members were asked if they wore their mask while performing overhaul. Of the 202 who participated in the questionnaire, 149 or 72.3% of the respondents answered yes, but 56 or 27.7 answered no, indicating they did not wear a mask while performing overhaul. The suppression members were also asked if everyone around them wore their mask while performing overhaul. Of the 202 respondents 3 did not answer, while 20 answered yes, that everyone around them wore their mask while performing overhaul. However, 181 or 90% of the 202 respondents answered no, signifying that not everyone wears their mask while performing

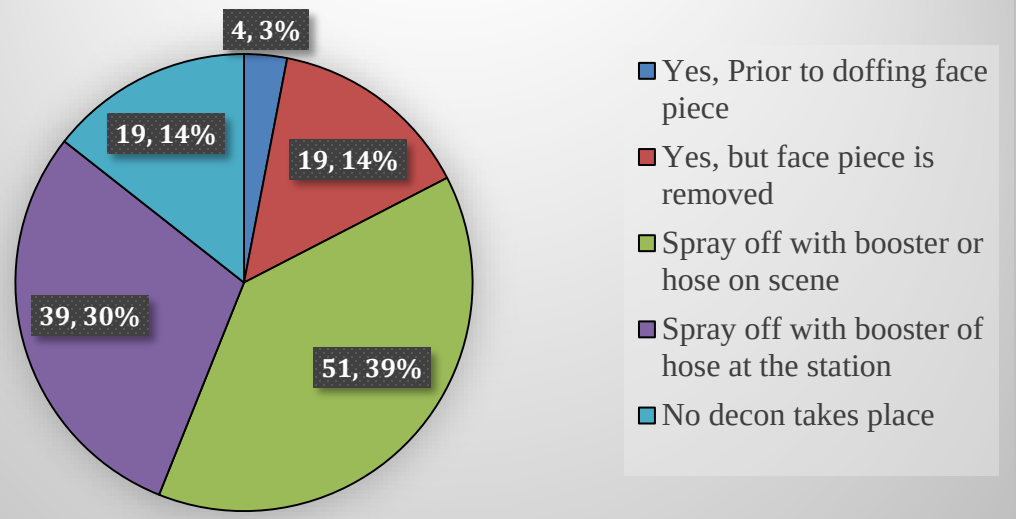
overhaul at structure fires. When asked if they ever said anything to this personnel they saw not wearing their face piece during overhaul, 131 or 64.9% answered no.

In order to explore inhalation exposures as related to contaminated fire gear, suppression members were asked if they rode with contaminated gear inside their fire apparatus when returning to the hall from fire runs. Overwhelmingly, 190 or 94.5% of the 202 surveyed answered yes, they rode beck to their stations with freshly contaminated fire gear in the cab. The practice of taking the face piece off and continuing to wear the turnout coat was also observed at every fire scene. However, the number of occurrences were not counted because describing the difference between wearing gear without a mask versus riding in the cab of the apparatus with exposed gear a few minutes later could become convoluted, as both scenarios cause members to continue breathing and being exposed to off-gassing contaminates.

In addition to riding with dirty gear in apparatus, firefighters also ride with dirty gear in their privately owned vehicles (POVs). Due to staffing issues, firefighters are required to travel and work at other fire stations to keep companies open. In order to do this, they have to take their gear with them. Because the NFD's financial managers find it less expensive to cover shortages in staffing with overtime rather that hiring to meet proper staffing practices; NFD suppression members may often transport this contaminated gear in their POVs and store it at their homes while waiting to be called in on overtime. Suppression members were asked using a questionnaire if they took dirty bunker gear home and/or does it ride inside the passenger compartment of their POV. Of the 202 respondents 71 or 35.1% answered yes, while 131 or 64.9% answered no. During personal observation, it was observed that this numbers who transported gear inside their POV would have been higher were it not for pickup truck ownership.

A less direct question asked of suppression members was if they performed on scene gross decontamination after fires. Gross decontamination was explained as the washing, brushing, and rinsing the turnout gear. Out of 202 respondents, only 4 or 2% said they practiced gross decontamination prior to removing their facepiece, which means the other 198 respondents have been exposed to the contaminants that are off-gassing from their turnout gear once they remove their facepieces (see Figure 1). While conducting personal observation, the wearing of contaminated turnout gear without a mask was observed 117 times correlating with the last question's results. Figure 1, shows that 23 or 21% of respondents conduct gross decontamination of their gear, while 141 or 70% of the respondents only rinsed their gear, and 38 or 19% who responded, did not practice gear decontamination at all.

Figure 1. Responses to performance of on-scene gross decontamination:



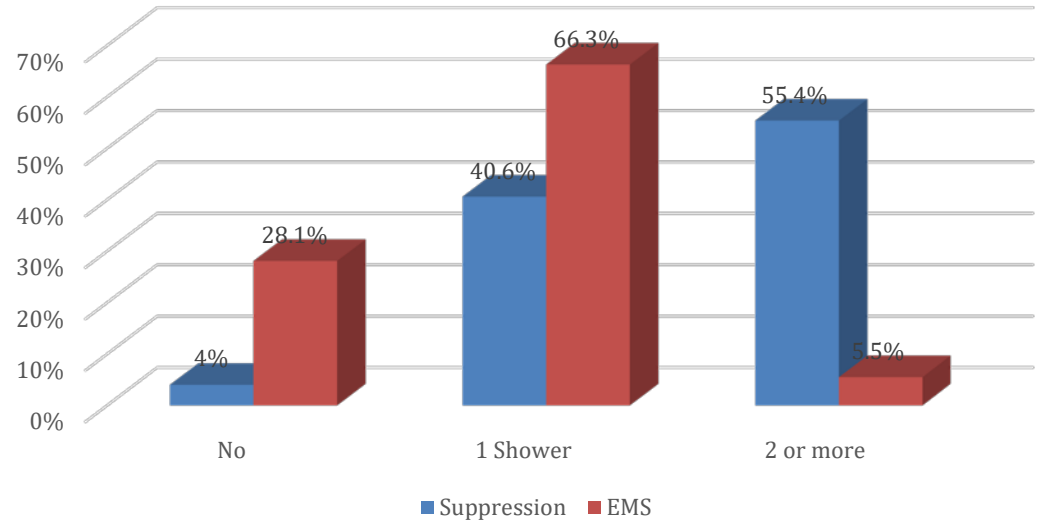
By not practicing gross decontamination of gear, firefighters are not only being exposed to carcinogens through inhalation but potentially being further exposed each subsequent time they or anyone else touches this contaminated gear.

The second route of exposure considered was dermal exposures to carcinogens. In order to assess the extent of carcinogen exposures occurring through the dermal route, suppression members were asked if they had their gear laundered after a fire. Only 36 or 17.8% of the 202 respondents answered yes, with the remaining 166 or 82.2% answering no, that their gear is not laundered after each fire. In addition, when asked about laundering their station uniform worn under their bunker gear, 129 or 63.9% or 202 respondents reported they did their laundry at home. Having noticed this trend during the research period, suppression members were asked if they wore gloves in the morning during shift change while handling their gear and the gear of the person they were relieving. Of the 201 respondents to this question, 17 or 8.5% responded yes, while 184 or 91.5% answered no, indicating they did not wear gloves while handling gear. EMS members do not have fire bunker gear, so they are not required to touch fire gear unless treating firefighters on a scene or while participating in medical monitoring. EMS members were asked in a questionnaire if they wore gloves while checking firefighters' vitals during medical monitoring. Of the 90 respondents, 79 or 87.8% answered yes, they wore gloves leaving 11 or 12.2% who answered no.

Fire suppression members were asked if their husbands, wives, significant others, or children had ever told them that they smelled like fire the morning after their shift. Of the 202 respondents, 166 or 82.2% answered yes, while 36 or 17.8% answered no. Similarly, EMS members were asked the same about smelling like fire when getting home after their shift. Of the 89 respondents to the question, 58 or 65.2% answered yes, while 31 or 34.8% answered no. While exploring dermal exposures more deeply, and wanting to know the difference in contamination to skin and hair of personnel who are directly exposed to thick pressurized smoke while inside structures versus personnel who stay outside working at a fire scene. For this reason

both suppression and EMS were asked if they smelled smoke while showering (see Figure 2). Of 202 suppression respondents, only 8 or 4% answered no, while 82 or 40.6% reported yes during the first shower after a fire only. Alarmingly 112 or 55.4% reported they smelled smoke for two or more showers after working on a fire scene. Of the 89 EMS members who responded to the question, 25 or 28.1% answered no, while 59 or 66.3% answered yes in the first shower only, and 5 or 5.6% answered yes for two or more showers after working a fire scene.

Figure 2. Percentage of respondents who smell smoke while showering after working fire scenes.



Members were asked if they took showers after working a fire scene, or if they get directly back in service and continue running medical calls the remainder of the shift. 87, or 96.7% answered no, indicating they immediately returned to service and ran medical calls.

The other two routes of exposure in which carcinogens enter the body are ingestion and penetration. Ingestion mostly involves putting something into the mouth with contaminated hands. This was observed on fire scenes 17 times during the observation period of January 15, 2018, through February 14, 2018, mostly by smokers and smokeless tobacco users. Ingestion observed during non-emergency periods came in the form of handling dirty and using smokeless

tobacco, which was observed 4 times and one cigarette smoker for a total of 5. Lastly, though very uncommon, is penetration. One injection was witnessed when a firefighter was cut with a soot-covered metal object after removing his glove, thus required the member to take a trip to the ED to have the wound irrigated, closed, and dressed (see appendix B).

The first research question was a), what are the most common ways NFD personnel are exposed to carcinogens. From the research, it can be observed that NFD employees are most commonly exposed through inhalation and absorption. The most common inhalation exposures found were unprotected breathing while too close to the hot zone, breathing the off-gassing by-products of combustion from contaminated PPE, diesel exhaust at hospitals and in station bays, and through not wearing a facepiece during all fire operations in the hot zone. The most common absorption exposures were contaminants penetrating PPE, not decontaminating PPE and then all subsequent handling, and cross-contamination of dirty PPE and station uniforms.

The second research question asked was, b) what are the NFD's current practices for minimizing the cancer risks among its personnel. When this ARP process was initially undertaken in October of 2017, there was no OPG in place to address exposure to carcinogens. There were, however, five different OPGs that listed practices that reduced exposure to carcinogens. One communicates the importance of keeping firefighter PPE clean OPG 1.46 (NFD, 2005). Another expresses the importance of not allowing apparatus to run while inside station bays and to have bay doors open prior to engine starting OPG 2.1 (NFD, 2017). The third is titled *Responsibility for Safety & Health,* which explains employee responsibilities to protect themselves and others, using proper safety gear and practices OPG 2.17 (NFD, 1999). In the fourth OPG, OPG 5.1, the location for on-scene rehabilitation is identified as being located in the

Cold Zone stating “If conditions permit, this site should be free of smoke and fumes and preferably upwind” (NFD, 2017).

The fifth and final OPG that discusses procedures that can reduce exposure to carcinogens was OPG 6.4, entitled *HAZMAT Response*, coauthored by the researcher of this ARP. Practices and procedures that are found within OPG 6.4 that would help reduce carcinogen exposure include: incident command implementation, hazard control zone establishment (hot, warm, and cold), accountability, risk profile establishment, on-scene decontamination prior to facepiece removal, no transporting contaminated patients, crew resource management, accountability, rehabilitation, medical monitoring, and exposure documentation (NFD, 2017). While fires are a more rapid-paced emergency than most hazardous material incidents, there are periods on the fire scene where much of the above-listed safety concerns can be considered and implemented with policy and training.

On February 01, 2018, OPG 1.53 was released entitled, *Carcinogen Exposure Prevention*, (NFD, 2018). Although a good starting point, OPG 1.53 lacks the global context to address current issues in NFD operations to maximize carcinogen reduction for both suppression and EMS members. Further, in order for OPGs to be effective, they must be read, trained, and enforced. The suppression section was asked if they had read the new carcinogen reduction OPG. 85 or 42.1% of the 202 respondents answered yes, while 117 or 57.9% answered no, indicating they had not read the OPG, though it had been out for three weeks. The EMS section members were asked the same question and of 89 responses 41 or 46.1% answered yes, while 48 or 53.9% answered no, they had not read OPG 1.53. Both the suppression and EMS members were asked what they would like to see addressed in a carcinogen reduction policy. The top 11

answers received are provided in the table below, (see Table 2). These answers came from 71 out of 202 suppression respondents and 44 out of 90 EMS respondents.

Table 2
Top eleven issues suppression and EMS members want to be addressed in a carcinogen OPG

Issue to be Addressed	Number of Responses
Education about reduction and avoidance	27
Presumption Legislation	22
Exhaust removal systems	20
Turnout gear laundered after fires	8
Enforcement of policies	7
Transport bag or tote for contaminated gear	7
Better decontamination practices	7
Exposure documentation	5
Hood/glove swap program	5
Hazard control zones	4
Personal Decontamination time allowance	4

Note. Response numbers from suppression and EMS shown above from 292 respondents.

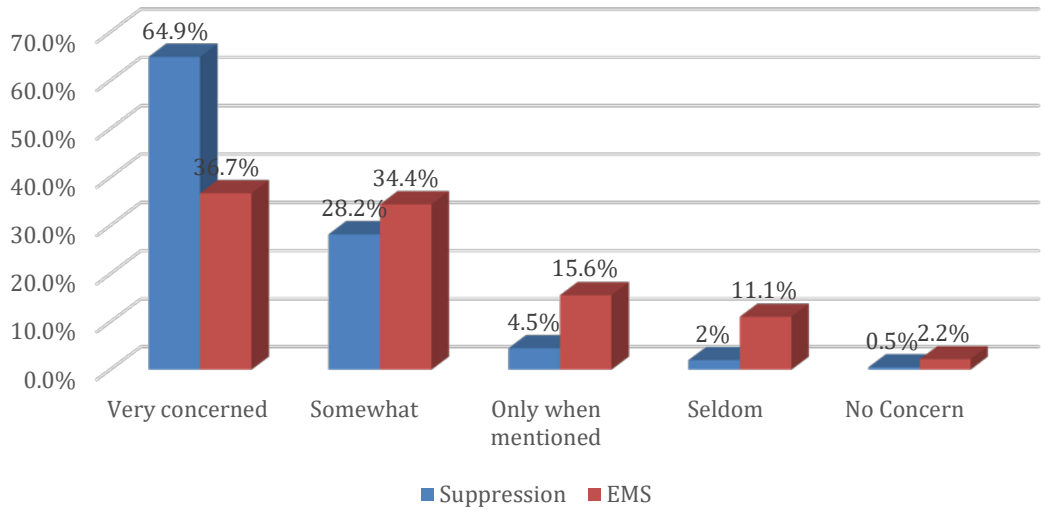
The second research question asked was, b) what are the NFD's current practices for minimizing the cancer risks among its personnel. From the research, it can be observed that there are some good OPGs in place that address small parts of the problem of carcinogen avoidance and reduction. However, there must be more research conducted to address the problem, as well as training and policy enforcement.

The third research question was, c) to what degree do employees within the NFD recognize and comprehend the threat posed to their health from carcinogens. In order to gain a perspective on the degree employees within the NFD recognized and comprehended the threat that was posed to their health from carcinogens, the researcher looked at the level of participation in the questionnaires that asked for their input. There were 1057 asked to participate in either a suppression or EMS based questionnaire to help with the research for drafting policy and procedures that will protect them by the future implementation of an OPG to reduce and avoid carcinogen exposures. After the questionnaire stayed open for three full weeks February 24 to

March 17, 2018, and with repeated reminders sent to give their input, only 292 responded. The ones that did respond, however, gave good input as can be seen in Table 2.

The leading answer both suppression and EMS members wanted to be addressed in a carcinogen avoidance and reduction OPG was education. In a question that asked both suppression and EMS members how concerned are you that past practices you have participated in may cause you to be diagnosed with cancer at some point in your lifetime, the dominant answers were very concerned and somewhat concerned. Only three of the 292 respondents answered, "it does not concern me at all" (see Figure 3). From the figure shown it is clear to see that there is a level of concern among respondents.

Figure 3. Percentage of respondents level of concern about past practices leading to cancer.



In addition to the level of concern, when suppression members were asked to identify the routes of entry for carcinogens, out of 202 respondents, 201 appropriately identified inhalation, 200 identified absorption correctly, and only 192 identified ingestion correctly. Suppression members also indicated in their questionnaire that they understood that if they wore their turnout gear correctly they could still become exposed to carcinogens on fire scenes, with only 1

answering incorrectly out of 202. EMS members understood that smoke and particulates from fire have been found to be carcinogenic with 84 or 93.3% responding correctly, leaving 6 or 6.7% requiring training about the properties of smoke. EMS members, when asked if they were aware that soot, the black stuff associated with wood fires, was carcinogenic, 79 or 87.7% responded yes, while 11 or 12.2% of the 90 respondents answered no. Although EMS members work for the NFD, they have not received classes on fire behavior and properties of combustion unless they have taken one outside of the NFD.

The suppression section was asked if they completed exposure forms after every fire. It was found that only 17 of the 202 respondents answered yes, with 185 answering no, indicating they have not filled out exposure forms after each fire. The EMS section was similarly asked about completing exposure forms following fires or exposure to diesel exhaust. Of the 90 respondents, 7 answered yes and 82 answered no.

It became clear during personal observations, that firefighters as individuals had worries and concerns about the dangers posed by carcinogens. Collectively, however, firefighters were ignorant of the threat carcinogens pose to their health or the health of those around them. As observed at the Nashville Fire Training Academy, 34 fire recruits were involved in some excellent training inside a flashover simulator on February 13, 2018. This required five separate burns in one day, which is quite an exposure to the instructors who sat in on as many as four out of five burns. After the training in which recruits wore their full PPE to include SCBA, no gross decontamination took place. Their gear was stored for the next 16 days in the classroom where they trained, except for when they wore it. It was finally stored in a nonliving area, the Friday before Hazmat training week. The gear was picked up the following Monday the 5th of March

and laundered. This standard was not new in Nashville as it occurred when the researcher went through recruit training and continued when the researcher trained recruits 2010 through 2012.

The third research question was, c) to what degree do employees within the NFD recognize and comprehend the threat posed to their health from carcinogens. A high level of concern about carcinogen exposure avoidance and reduction can be observed from the research, though a lower level of understanding of the threats posed by carcinogens remains. The NFD members that actually responded admitted to wanting to know more about how to reduce exposure and how to better protect themselves when they are exposed.

The fourth and final research question was d) what guidelines and procedures have other fire departments across the nation implemented to minimize exposure of their personnel to carcinogens. In order to answer this question, an appeal was made to fire service professionals to complete a questionnaire regarding carcinogen avoidance and reduction of exposures. Also, if they had policies in place addressing carcinogen reduction that could be shared, they were asked to email a copy to the researcher. The level of participation was less than desired, but the questionnaire did receive 67 responses, and 3 policies were obtained.

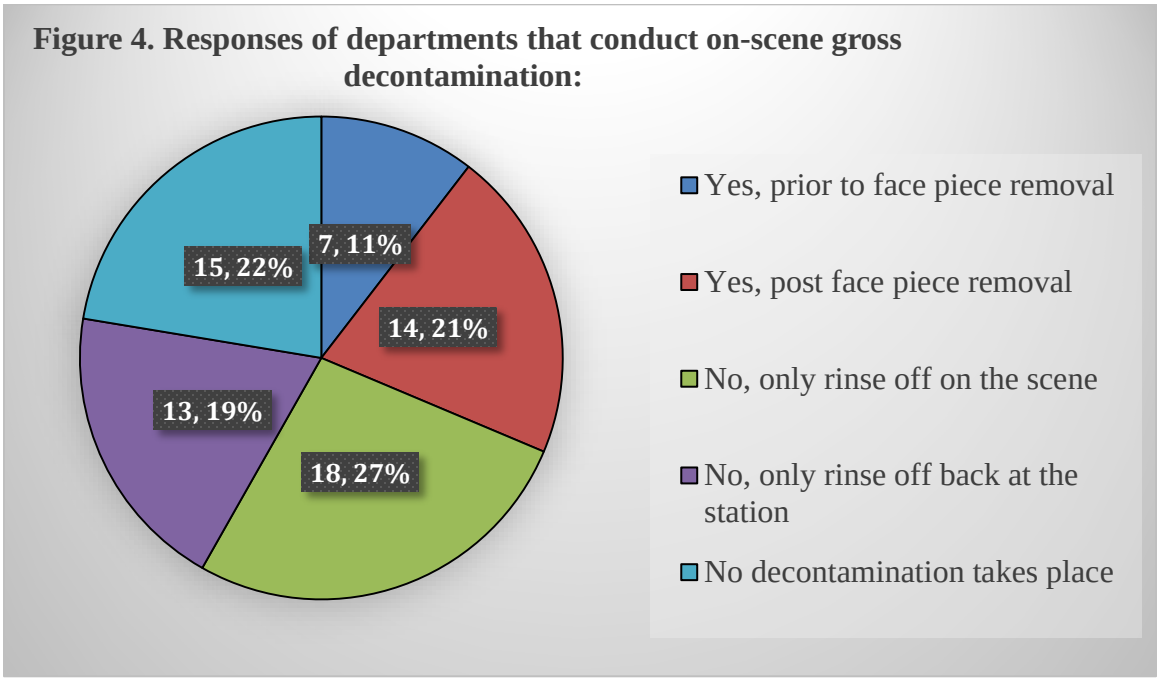
Fire officers from fire departments outside of the NFD were asked if they had a policy in place to address carcinogen exposure. Of the 67 respondents, 21 or 31.1% answered yes and 46 or 68.7% answered no. Furthermore, these officers were asked if their departments did not have a carcinogen reduction policy, did their departments address carcinogen exposure in other policies. There were 66 responses to this question, 38 or 57.6% answered yes, that their department addressed carcinogen exposure in other policies such as decontamination, PPE, vehicle exhaust, etc. Of the remaining answers, 12 or 18.2% stated no, while 16 or 24.2% answered that they had a carcinogen exposure policy. When asked if their departments trained their members how to

reduce exposures to carcinogens, 47 or 70.1% of 67 respondents answered yes and 20 or 29.9% answered no.

Officers from other departments were then asked if in the event a member of their department required medical transport, were they decontaminated or did they have their bunker gear removed prior to transport. Of the 67 respondents, 39 or 58.2% answered yes and 28 or 41.8% answered no. These officers were asked if their departments had a hood exchange program. Out of 67 respondents, 37 or 55.2% answered yes while 30 or 44.8% answered no. When asked if station uniforms were cleaned at work or by a laundry service, 9 or 13.4% answered that their departments had a laundry service, 52 or 77.6% answered their stations provided washers and dryers, leaving 6 or 9% of the 67 respondents answering that their members cleaned their uniforms away from work.

One of the questions in the questionnaire asked officers from other departments if their departments practiced on scene post-fire gross decontamination by using a wash, brush, and rinse method. Only 7 of the 67 respondents answered yes prior to facepiece removal (see Figure 4).

Figure 4. Responses of departments that conduct on-scene gross decontamination:



Of those remaining answers, 14 answered yes after facepiece removal, 18 indicated that they hose off gear on scene, 13 answered they hosed off gear back at the station, and 15 answered no decontamination takes place (see Figure 4).

The questionnaire to other departments also inquired about personal decontamination. Other departments were asked if their equipment carried decontamination items such as wet wipes and/or soap to wash the areas of the face, neck, and hands after fires. Of the 67 respondents, 45 or 67.2% answered yes, while 22 or 32.8% answered no. When asked if crews were placed out of service for any length of time after fire responses to decontaminate gear and shower, the respondents indicated that 20 or 30.3% of 67 respondents' departments allowed time for decontamination and showers. The remaining 46 or 69.7% respondents answered no, with one respondent not answering. When asked if other departments' members ride in apparatus with dirty of contaminated gear in the cab, 54 or 81.8% responded yes, their members rode with contaminated gear in the cab, 12 or 18.2% responded no, and one respondent did not answer.

Regarding PPE, these department fire officers were also asked if their department washed turnout gear after a fire, 42 or 62.7% answered yes, while 25 or 37.3% of the 67 respondents answered no. They were further asked if their departments provided two sets of turnout gear for each of their members. Of the 67 respondents, 26 or 39.4% answered yes, while 40 or 60.6% answered no there was no second set for members, and one did not answer.

Fire officers were asked if their members documented exposures on any kind of paperwork after each fire. Of the 67 respondents, 14 or 20.9% answered yes and 53 or 79.1% answered no, their departments did not have exposure reporting. When asked about station diesel exhaust removal systems, 44 or 65.7% answered yes confirming their departments had them, additionally 6 or 9% answered their departments were in the process of getting them, while

17 or 24% answered no indicating their departments do not have exhaust removal systems. One question posed to outside department officers asked in the questionnaire was, what is their departments' penalty for not wearing SCBA during overhaul, dumpster fires, or car fires. The top answer provided by 21 of the 64 respondents who answered the short answer open-ended question was "none". Other responses to the question included progressive discipline, counseling, verbal and written reprimands, and coaching.

The fourth and final research question was d) what guidelines and procedures have other fire departments across the nation implemented to minimize exposure of their personnel to carcinogens. From the research, it can be observed that while the majority of departments represented in the questionnaire did not have a singular policy addressing carcinogen reduction, the majority did address the issue within other policies, leaving only a minority not addressing carcinogen exposure in any type of policy. It was also observed that the majority conducted training in avoidance and reduction of exposures. Interventions reported to be utilized by the majority of outside departments were firefighter patient decontamination, hood exchange programs, in-station laundry of uniforms, post-fire laundry of turnout gear, providing personal decontamination equipment, and diesel exhaust removal systems in stations. Additional interventions used by other departments, but only as the minority of those questioned included policy enforcement, on-scene decontamination, post-fire decontamination time to shower, and exposure documentation.

Discussion

In this section, the research conducted through questionnaires and personal observation will be compared and contrasted with the findings of others as presented in the literature review. This analysis will be used to show relevant ideas and interventions that a future policy should

address in order to meet the original purpose of this research, which was to identify, develop, and implement best practice standards to prevent and reduce NFD personnel's exposure to carcinogens.

Occupational exposure to carcinogens and the cancers they generate have become a popular topic of discussion in the fire service over the last 20 years. Only time will tell if the current trends and rates of firefighters contracting cancer have peaked or continue to rise, and if the numbers continue to rise, how they can be alleviated. As Percivall Pott discovered, or at least those who proceeded him in his studies, hygiene can make a difference in cancers that are caused by carcinogens absorbed through the skin (Herr, 2011). Though many advancements and studies have occurred Since Pott's first discovery over two hundred years ago, good hygiene is still very effective in cancer prevention (Fent et al., 2017). Soap and water go a long way in the decontamination of firefighters' gear, as well as their bodies, thus reducing the level of exposure and eliminating subsequent exposures and cross contamination.

The literature listed an abundance of carcinogens, particularly PAHs and VOCs that can permeate firefighter turnout gear and be absorbed through the skin (Fent et al., 2014; IARC, 2010). The chemicals that have been labeled as carcinogens are present in modern structure fires because of the use of synthetics, plastics, and petroleum-based products used in the construction and furnishing of modern buildings. When these structures burn, chemicals are released from these materials in the form of smoke particulates (Khazan, 2015). These toxic atmospheres are associated with the elevated relative risk of firefighter cancer as identified in several studies (Daniels et al., 2015; Glass et al., 2014; LeMasters et al., 2006; Pukkala et al., 2014).

When worn appropriately, PPE along with an SCBA is the firefighters' first line of defense against these toxic atmospheres. However, these toxins adhere to the PPE and must,

therefore, be washed off. Ideally, these contaminants need to be washed off prior to removing the firefighter's facepiece, as they continue to off-gas for some time after exiting the dangerous atmosphere (Fent et al., 2017). During the research, this area was identified as a problem within the NFD, as there is no standardized gross decontamination, nor a standardization of doffing SCBA and turnout gear. Additionally, the contaminated gear is often found in the same area as rehabilitation, then later placed into the cab of the apparatus for the trip back to the fire station where extended exposure can occur. Finally, although the NFD has two sets of turnout gear for each suppression member, as observed in the research, the majority of respondents (82.2%) do not get their contaminated PPE laundered. This poses the question of how many suppression and EMS members are becoming cross-contaminated as a result of not cleaning gear either through gross decontamination or the NFD gear laundry procedure as prescribed in NFD OPG 1.46 (NFD, 2005).

The problem of not decontaminating gear cannot be overstated. When inquiring of outside departments, as well as NFD employees, it was found that contaminated gear effects not only the NFD but other departments as well through the routes of inhalation and absorption exposures. These exposures occurred as a result of contaminated gear being stored for travel inside apparatus and POVs. Further exposure occurred when handling the contaminated gear every time the responder made calls or was found to be taken inside firefighters' homes or living quarters at the fire station. From findings in the questionnaire and personal observations made, it was noted that station uniforms were taken to firefighters' homes for washing, as indicated by 63.9% of the respondents. Studies have found these uniforms to be contaminated when worn under turnout gear (Fent et al., 2014). The possibility of cross-contamination with the firefighters' family members exhibits a level of disregard that must be addressed with education.

Most NFD fire stations have washers and dryers, although the training academy currently only has one utilized solely by its staff, and is not used by recruits.

Another exposure risk that should not exist, is the performance of overhaul while not wearing a facepiece. 27.7% of 202 NFD suppression respondents admitted that they do not wear their facepiece when conducting overhaul. An additional 181, or 90% of that same 202, admitted noticing other firefighters around them not wearing their facepiece when conducting overhaul. When asked if they spoke up and mentioned to these firefighters that they were not protecting themselves during overhaul, 131 or 64.9% of the 202 said no. Vincent Dunn notes that overhaul is the stage of fire operations more toxic than when flames are present, yet the NFD has members who seem afraid or ashamed to say anything to their own brothers or sisters working unprotected in these conditions. (Dunn, 2018).

Surprisingly, it was also discovered that EMS crews have been exposed to carcinogens from breathing smoke as a result of either being too close to fire ground operations or not paying attention to wind shifts. The EMS division is a separate entity within the NFD performing only EMS related functions, and therefore does not receive fire training. Education about the subject of carcinogen avoidance and reduction was at the top of the short answers given when both EMS and suppression members were asked what they would like to see addressed in a carcinogen reduction policy. It should be noted that the majority (70.1%) of outside departments surveyed admitted to training their personnel on how to avoid and reduce carcinogen exposure in conjunction with policy.

In addition to training, establishing hazard control zones on fire scenes, in the same manner the Phoenix Fire Department prescribes in their policy, would add a level of safety to all responders operating on-scene as well as keep unprotected NFD members from breathing smoke

unnecessarily (Phoenix Regional, 1999). Though the idea may be dated, its application is effective, as exhibited by its implementation of every department conducting hazardous materials responses, including the NFD. In NFD OPG 6.4, the IC is tasked with establishing risk profiles in an effort to reduce exposures to hazardous atmospheres in addition to managing operational personnel and accountability. This includes ensuring on-scene decontamination of contaminated personnel and patients prior to being transported (NFD, 2017). Transporting personnel as patients who were still wearing contaminated bunker pants saturated with carcinogens and other toxins was another way EMS members and hospital staff were identified as being cross-contaminated. 68.9% of respondents admitted to having taken part in this avoidable practice.

Answers from the two questionnaires posed to NFD employees indicated that greater than 70% of EMS respondents and 95% of suppression respondents smelled smoke emanating from themselves while showering after working fire scenes. The NFD currently does not purposefully put units out of service for personal decontamination, though some officers elect to make the opportunity for their crews. When asked if they took a shower after fire scenes or returned to service to run medical calls, the overwhelming majority indicated that they did not take a shower until they finished their shift, meaning these employees were exposed to larger doses of contamination than they should have been. This is contrary to the practice of dose-limiting of showering and changing clothes, as discussed in an article regarding the post-fire environment (Clark & Hadaway, 2017).

The NFD has several OPGs in place that address only parts of the problem of carcinogen exposure. For instance, NFD OPG 1.53 says it addresses carcinogen exposures (NFD, 2018). Yet when NFD personnel leave a fire scene to run medical calls without having been provided the opportunity to shower, it is an obvious indication that the department's policy was not

predicated upon scholarly research. This practice of leaving and returning to service without showering isn't addressed anywhere in policy and is further indication that appropriate adjustments need to be made. In the literature, Boston Fire expresses that similar problems led them to reach out to the academic world for assistance. At some point, the NFD should consider following the lead of the Boston Fire Department (Mackin, 2016).

By observing the number of suppression and EMS members who have not read the new carcinogen reduction OPG, it becomes apparent that NFD employees do not invest much time or effort in educating themselves on the topic of carcinogen exposure. This behavior is contrary to a questionnaire in which they indicated they were concerned. Furthermore, when 1,057 fire suppression and EMS members were asked to weigh in on a questionnaire specifically designed for their job section, only 292 took the opportunity to participate, thus indicating an air of no concern. After observing practices at fire scenes, as well as what occurs afterward, it can be stated that NFD employees do not fully recognize and comprehend the threat posed by exposure to carcinogens. Though the vast majority are exposed, they do not decontaminate properly, thus leading to repeated exposures. NFD employees have chosen not to document their exposure either on the appropriate NFD exposure form or in the narrative of NFIRS reports. Even though Tennessee currently has presumptive legislation, it would be tragic for an NFD employee to endure similar struggles as Delmis Spivey experienced while settling his cancer claim as noted in Spivey v. City of Bellevue (Varone, 2017).

When looking to other fire departments to see what practices and standards they employ, it was noted that though some departments have been working on and studying the topic of carcinogen reduction and cancer prevention for the past two decades, the fire service as a whole has not kept up. The IAFF just hosted its first cancer summit in February 2018 signaling the

topic of cancer and carcinogen reduction has reached the national and international levels of discussion (Schaitberger, 2018). In the literature review, two EFO ARPs authored sixteen years apart recommended similar findings. These included a need for policy, training in addition to policy, the use of SCBA, decontamination of PPE, laundering of uniforms at the station, keeping PPE out of living quarters, and policy enforcement (Brinker, 2017; White, 2001). Through the questioning of officers in other fire departments, it was observed that many of the recommendations made by Brinker and White apply to the NFD as well as the use of a hood exchange program, documentation, health screenings, diesel exhaust removal systems, and adequate personal decontamination time to include the use of wipes on scene.

Of all of the interventions and control measures recommended to reduce NFD personnel's exposure to carcinogens, only diesel exhaust source capturing systems would incur a large expense upon the NFD. Decontamination of gear on-scene and controlling the cross-contamination of that gear until it is laundered would be inexpensive. Enforcing a policy that is in place, assuring that policy is trained to personnel, as well as ensuring the wearing of SCBA at all fire operations within the hot zone are also inexpensive. Providing personnel time to decontaminate after fires may cause other companies to have to make a few more calls during the thirty-minute post-fire period, but again at no additional monetary cost. Laundering turnout gear after each fire exposure would be an additional expense, although it should be nominal, as the NFD already owns extractors to launder gear annually.

The researcher purposely stayed away from researching cost, as this could be a stand-alone ARP, and did not want his judgment of best practices impeded by price tags. Most practices reducing NFD personnel exposure to carcinogens are inexpensive, if not free, and carry minute financial implications. It costs nothing to wear an SCBA, which is already provided, and

very little more to keep PPE clean. Until the NFD can afford diesel exhaust source capturing systems, OPG 1.53 released in February 2018, offers cost-effective solutions to the exposure of diesel contaminates, if personnel elect to follow them (NFD, 2018). No matter what remains in the final policy draft produced from this research (see Appendix F), the director-chief should approve a proactive policy that can be supported and enforced not only by the chief officers and captains, but also by the Firefighters IAFF local 140 to ensure that all personnel receive the best information and training to protect them from the hazards of carcinogen exposure.

Short term implications will call for NFD members to change the way they conduct operations causing some company and command officers to have some uncomfortable conversations with their personnel. As accountability increases, safety and productivity should follow suit. As a result of the latency period from carcinogen exposure to a cancer diagnosis, long-term implications may take one or two decades to be fully observed, though fewer NFD personnel should suffer its effects.

Gaps in the literature were found including how to properly doff gear that is contaminated at the fire scene, or what steps to take post-fire to eliminate toxins and carcinogens from the body. There is a lot of buzz about saunas, yet the human body rid itself of toxins not through sweat but urine via the kidneys. Also, control zones at structure fires need to be researched and implemented. On fire grounds of the NFD, there are too many instances in which ISOs have to tell well-intentioned engineers, medics, firefighters, captains, and chiefs to get back or put their PPE on. Finally, the American fire service needs to establish a risk profile in order to keep firefighters safe. At the time of this writing, long-term exposure to carcinogens and its effects, are not applied to current risk versus benefit profiles.

Recommendations

The purpose of this Applied Research Project (ARP) was to identify, develop, and implement best practice standards in order to prevent and reduce NFD personnel's exposure to carcinogens. The action research method was chosen because the researcher's department did not have a policy in place to address the prevention and reduction of carcinogen exposure for NFD personnel. The research was comprised of a literature review as well as reviewing existing NFD Operational Procedures and Guidelines (OPGs) to identify policies that may already partially address carcinogen prevention and reduction. Personal observations were conducted in order to see how NFD personnel were being exposed to carcinogens. Three surveys were designed to assess to what degree NFD personnel recognize and comprehend the threat carcinogens pose to their health. Finally, other fire departments' policies were examined and a survey was conducted to identify how other departments address carcinogen exposure in terms of policy and procedure.

Recommendation #1

The Nashville Fire Department needs to develop and adopt an OPG that addresses avoidance and reduction of carcinogens. The policy submitted includes:

- ICs responsibility in establishing hazard control zones and a risk profile for every fire scene.
- Rehabilitation and medical monitoring should take place in the cold zone.
- SCBA will be worn anytime personnel are inside the hot zone and should not be doffed until gross decontamination has taken place.
- Gross decontamination of all personnel exiting the hot zone shall be conducted at every fire to include when firefighters are transported by EMS.

- Uniforms should be laundered at the station.
- Bunker gear should be laundered after every fire, to include gloves and hoods.
- PPE that is not laundered (facepiece, helmets, boots, and SCBA packs) should be cleaned in designated areas.
- PPE should never be inside living areas of fire stations and contaminated gear should never be in apparatus cabs.
- Control efforts shall be used to minimize diesel exhaust exposures.
- Documentation of all fire exposures will be documented in NFIRS and on the appropriate NFD exposure form.
- Suitable time will be allowed after fires for all members to conduct personal decontamination and change clothes.
- All equipment to include the inside of the apparatus cab will be cleaned after every fire as soon as possible upon returning to the fire station.
- Recruits participating in class A training burns will follow the carcinogen reduction policy and be afforded the same methods to clean uniforms as well as personal decontamination.

Recommendation #2

The final adopted carcinogen avoidance and reduction policy should incorporate a training period in which chiefs and captains ensure all members have read and understand the expectations of the policy in place. District and company training can address final approved methods for gross decontamination and PPE doffing to ensure uniformity.

Recommendation #3

Once trained, the final adopted carcinogen avoidance and reduction policy should be strictly enforced. Chiefs and captains should use coaching and progressive discipline to ensure unnecessary exposures and risks will not be tolerated.

Recommendation #4

The NFD needs to research the cost of diesel exhaust source capturing systems as well as grant monies that may be available to install these systems. Once researched, the NFD should develop a plan to purchase and incorporate source capturing in all existing stations and not build another station without it.

Recommendation #5

The Nashville Fire Department should study the extent of the diesel exhaust problem in the confined receiving areas at Nashville area hospitals and meet with hospital representatives to discuss options that better protect NFD EMS personnel who are exposed in these areas.

Recommendation #6

Research should be conducted continually and applied to the carcinogen avoidance and reduction policy to ensure that the NFD's OPG regarding carcinogen avoidance and reduction stays current. An example of this would be researching the new cancer hoods for NFD suppression members.

These recommendations were derived from hours of reading and searching through the literature, followed by independent research conducted on the NFD suppression and EMS divisions, as well as EFO students and graduates from other departments across the United States. In order for the recommendations of this APR to achieve their intended purpose, the administration of the NFD will need to consider and support these recommendations.

Future readers and researchers should examine how to detoxify the body as studies in this ARP clearly show wearing current PPE will not stop exposures to carcinogens. Also, future research may include an analysis of firefighters' attitudes and behaviors to discover if the fire service can progress beyond unsafe practices such as not wearing SCBA when conducting overhaul.

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Appendix A
Personal Observational Data Form
Tallied for January 15, 2018 to February 14, 2018

Address_____Date_____ Time_____

Inhalation

Exposure Type	Emergency	Non-emergency	Attributing Factors
No SCBA Overhaul	**4**	**0**	
Doffing Exposure	**32**	**0**	
Cntd. bunker no mask	**117**	**12**	
Hot Zone exp. no mask	**46**	**0**	
Cross Cntd. exposure	**57**	**15**	
Dirty gear transport	**32**	**11**	
Dirty gear living area	**0**	**7**	
Diesel Exhaust	**18**	**35**	**Number equals personnel in vehicle**

Comments_____

Ingestion

Eating/smoke/dip scene	**17**	**0**	
Eat/smoke/dip shift change	**0**	**5**	

Comments_____

_____

Dermal

Fire Exposure in Gear	**157**	**0**	
Soot on skin	**38**	**8**	
Handel Cntd. Gear	**79**	**108**	
Wear Cont. gear	**28**	**33**	

Comments_____

_____

Injection

Cuts on fire scenes	**1**	**0**	

Comments_____

_____

Best Practice Standards Observed That Reduced Carcinogen Exposures

_____

_____

_____

Observations Made from January 15, 2018 through February 14, 2018

Total Layouts	Total Exposures	Direct Exposures	Indirect Exposures
36	**1016**	**509**	**507**
Bottles used	Exposure Forms	On Scene Decon	Double shift Exposure
610	**3**	**14**	**Chiefs, Rescues, & Trucks**
Inhalation	Ingestion	Dermal	Injection
386	**22**	**451**	**1**

Note. Total exposed is the number of personnel present at all 36 fire layouts.

Appendix B
Suppression Section Questionnaire – With Answers

Hello, please take a moment to complete this questionnaire in an effort to help gather research materials aimed at reducing exposure to carcinogens. All responses are strictly confidential and can only be seen by me. Furthermore, by clicking on the link, I can only view responses and will not be able to see specific individual responses. Please be as honest as possible but remember the goal of my research is to gather valuable information to help reduce firefighter cancer, not bash the department. Your input is valuable to helping establish ways to keep our personnel safe and healthy.

How concerned are you that past practices you have participated in may cause you to be diagnosed with cancer at some point in your lifetime?
Very Concerned– 131 (64.9%)
Somewhat Concerned– 57 (28.2%)
Only when the subject is brought up– 9 (4.5%)
I seldom think about it– 4 (2%)
It does not concern me at all– 1 (0.5%)

How concerned are you on the topic of firefighter cancer?
Very concerned, I have researched it– 97 (48%)
Somewhat concerned, I have read a few articles– 101 (50%)
I have never paid attention to the subject/unaware– 3 (1.5%)
It is not a concern of mine– 1 (0.5%)

Is your helmet clean or does it look like you fight fire for a living?
Yes, it's clean 115 (56.9%) No, I fight fire for a living. 87 (43.1%)

Do you have your gear laundered after every fire? Yes 36 (17.8%) No 166 (82.2%)

Do you launder your station uniform at home that was worn under your bunker gear after fires?
Yes 129 (63.9%) No 73 (36.1%)

Do you understand the dangers of diesel exhaust? Yes 175 (86.6%) No 27 (13.4%)

In the morning when completing check offs, is the fire apparatus running in the bay at any time while being checked off by the engineer/AIC engineer? Yes 110 (54.5%) No 92 (45.4%)

Does your engineer wait until everyone is on board prior to starting the engine?
Yes 53 (26.2%) No 149 (73.8%)

Do you ride with contaminated fire gear inside the apparatus after fire runs on subsequent calls and/or returning to the hall? Yes 190 (94.5%) No 11 (5.5%)

Do you think you can get cancer from natural wood, fibers, paper, etc., combustible product fires or is it just from synthetics, plastics, and petroleum based fires?
Yes, all materials can cause cancer– 174 (86.6%)
No, only synthetics, plastics, and other chemicals– 27 (14.4%)

Do you wear your mask while preforming overhaul? Yes 149 (72.3%) No 56 (27.7%)

Does everyone around you wear their mask while performing overhaul? Yes 20 (10%)
No 181 (90%)

Do you ever say anything to personnel you see not wearing their mask while performing overhaul? Yes 66 (32.7%) No 131 (64.9%) I never see this 5 (2.5%)

Do you take dirty bunker gear home and/or does it ride inside the passenger compartment of your private owned vehicle? Yes 71 (35.1%) No 131 (64.9%)

If you travel and make a fire how does your gear get back to your assigned station?
POV inside vehicle– 88 (43.8%)
POV in truck bed– 98 (48.8%)
Department vehicle– 14 (7%)
It is picked up laundered and returned to my station– 1 (0.5%)

Do your wear gloves when handling your gear and the gear of the person you are relieving in the mornings at shift change? Yes 17 (8.5%) No 184 (91.5%)

How can carcinogens enter the body? (check all that apply)
Absorption– 200 (99%)
Inhalation– 201 (99.5%)
Ingestion– 192 (95%)

If you wear all of your turnout gear correctly can you still become exposed to carcinogens at a fire scene? Yes 201 (99.5%) No 1 (0.5%)

Do you complete exposure forms after every fire? Yes 17 (8.4%) No 185 (91.6%)

Do you know what the radon level was at your hall pre and post abatement and have you filled out an exposure form accordingly? Yes 12 (5.9%) No 190 (94.1%)

Do you or anyone else take their quick hitches/bunker pants and boots into the bedroom at the fire hall? Yes 66 (32.7%) No 136 (67.3%)

Do you wash your face piece after every fire? Yes 157 (77.7%) No 45 (22.3%)

Where do you wash your face piece?
Bay– 58 (28.7%)
Decontamination room at the hall– 72 (35.6%)
Inside one of the sinks in the living areas of the hall– 72 (35.6%)

Do you perform an on scene gross decon of your gear after fires? (decon requires wash, brush, and rinse)
Yes prior to doffing my face piece– 4 (2%)
Yes, but my face piece is removed– 19 (9.4%)
I only spray it off with the booster or a garden hose on the scene– 102 (50.5%)
I only spray it off with the booster or a garden hose back at the hall– 39 (19.3%)
No decon or rinse takes place– 38 (18.8%)

After a fire do you smell smoke in the shower?
No– 8 (4%)
Yes, first shower only– 82 (40.6%)
Yes, for two or more showers– 112 (55.4%)

Has your husband, wife, significant other, or children ever told you, you smell like fire the morning after a shift? Yes 166 (82.2%) No 36 (17.8%)

Do you drink plenty of water after a fire so that you have to urinate several times within a few hours? Yes 147 (72.8%) No 55 (27.2%)

Do you know what the current cancer presumptive legislation covers for you as a firefighter in Davidson County, Tennessee? Yes 45 (22.3%) No 157 (77.7%)

Have you read the current carcinogen exposure prevention policy? Yes 85 (42.1%)
No 117 (57.9%)

What if anything would you like to see the policy address?
I'd like to see the dept issue particulate hoodsx2... We should have bags to put gear in when contaminated and sent for cleaning and for POV travel Ideally we should have a vehicle that carries our back up gear so that we can change out on scene and gear can be cleaned instantly...
The emphasis on cleaning helmets/flaps, gear, running equipment inside bays, that cancer is real, aerobic exercise after making fires and showers help remove toxins from the body..ie Hair that smells of smoke...etc...should be taught at Recruit level and taught at inservice every year... Thank you for covering this so important topic which is imperative to us, our brothers, sisters and families.., Be Safe Chief

Its definitively something that needs to be addressed. In my professional opinion I believe everyone needs to be more educated about our old habits that are causing these cancers and hopefully can make changes on the fire scene and im the firehall to help correct some of the issuies. Although realistically I believe we will always be at risk no matter what changes are made.

When cancer hits there are a few people who take the stance of well they were going to get this anyway, it seems as if they are not in complete understanding of just how big of a problem in the Fire service this is. It seems as it is left up to Us to prove how we got cancer, as if we aren't all ready under enough pressure without having to deal with the cancer itself. Put the Fire Fighters safety first and for most, after all if not for the Women and Men of the EMS & Suppression they would not have a Job.
I'd like to see a wider range of protection offered for firemen, both retired and those still on active duty. The simple fact is that we are exposed to harmful, cancer causing materials under even the most calm and low stress environments; all in the name of public safety. It shouldn't be too much to ask for protection against these career-ending, perhaps even life-ending illnesses contracted while performing our duties.

Bunker gear cleaning from logistics, more than every 6 months.

I would like to have new gloves and nomex hoods given to us after every fire.
for the fire department to provide us with large commercial washers and dryers in the firehalls so we can wash our turnout gear more often or when ever we want.

A designated decontamination period after a working fire. Example: we recognize the need and necessity for decontamination in the fire department but when we do get a working fire there is no time for a shower. We receive calls on our way back to the hall and shortly after returning from the fire which requires us to rush into action. I despise being "caught" in the shower! its a true problem that there is not "Decon Period" for firefighters after a working fire.

Logistics has been resistant to Firefighters receiving a second hood, gloves so that we may wash our first set. This is strange to me because we recognize a need for a second set off fire fighting gear but they do not want to give us a second hood and gloves. We need a second hood and gloves so that we may decon the gear we used at the working fire and have a clean set to wear to the next fire.

Standard post fire decon. More manpower at companies for overhaul. Exhaust removal at halls. Old reserves with bad exhaust put out of service. Fire and ambulances. In hall monitors of exhaust levels in bay in every hall. Inspections of gear in hall for dirty gear.

I have seen in the past firemen who have had cancer denied by metro

If we are at the Station or at a fire inside or outside we should have the security of knowing we will be fully covered if we get cancer of any kind.

Better hoods, and having an actual decon room in the fire hall, and eventually the UV cleaners that don't break PPE down the way washing after every fire deteriorates the gear

Cover people with cancer without denying them first, not running apparatus in bays, hoses to remove diesel, newer stations that separate bays and living quarters. Have someone document and submit 101's for people after each fire
.
Enforcement of more things related to this topic.

Salvage an Overhaul an some form of light gear.
Wearing of SCBA during post fire during salvage and overhaul

Be more proactive in addressing cancer.
For all boards including Benefit, IOD, etc. to have a better understanding of absorption. Wearing full PPE and still smelling your body off gas smoke for 4 or 5 days needs to be addressed and understood by people responsible for denying claims.

easier ways to get my gear cleaned when I travel...I travel almost every other shift...am I to carry both sets of fire gear everywhere? I don't have a lot of space in my vehicle for two sets...I try to put my gear in my trunk so an exposure is less, but I need to carry other items with me (extra clothes, cleaning aids for myself in showering, towels, etc.) and I would not like them visible to the general public so they are in my trunk too, so they are being exposed also.

I would like to see updates and know more about what else is out there that's harmful to firefighters and medics.

I wish the administration would spend more time and money on prevention rather than exemption.

cover our whole career from cancer !!! period !

unknown

NA

would recommend additional options of "most" and "some" in addition to Yes/No responses- I had to say yes if done >50%- it would have been more accurate to say "some"

This is Buddy Byers,our PPE Committee has been studying these concerns and writing policies.In the recent OPG concerning cancer we looked at firefighting gear inside POV and firefighters traveling ,it is a growing policy .Since the NFD has done little to address this we are progressing taking baby steps.Most things we try to implement we are meet with "We have no money" ! You mentioned exposure forms we asked to have that added to our fire reports.We are pushing for a new hood policy,exhaust

systems in all bays.Notice all the fire halls were gear storage has been to bay areas.I would like to know how many respond to this survey.How many of our people have read the new cancer OPG ?

At one time I thought Cancer presumptive legislation covered all Cancer, but in recent years I am not sure. Got a run got to go. Great survey!

Swapping out hoods and gloves on scene after every fire. Replacing my PPE with the exact equipment I just used. Don’t try to exchange equipment for second rate gear.

Due to the weight of the current SCBA, I would like to see the department supply filtered mask for overhaul operations to be allowed after on scene commander deems it safe to do so. I feel people choose not to wear their SCBA during overhaul because of the weight and exhaustion. I do believe people would wear the mask because it is less exhausting and I believe it would beneficial in reducing exposure to asbestos and off gases.
lighter air packs like we used to have so I can wear my mask after the fire during overhaul or a filter for our mask so that we don't have to wear the air pack during overhaul. Any one who goes through a few bottles knows how shitty the airpack feels at the end of the fire. Also supply us with new hoods after each fire and not act like its the end of the world when we ask for things. Some fire deoartments are giving ultrasounds of the neck area to check for cancer but we don't.

Firefighter protection, not finding ways firefighters neglect.

The details /clarification of the presumptive policy.

Older halls have poor ventilation and gear stored exposed in bay.

That it is automatic that the gear is washed. It is not placed in the vehicle until cleaned. Exhaust systems in all halls.

Start with appropriate in hall vehicle exhaust removal systems that hook to tail pipe.

Our logistics is closed on the weekend and holidays so it’s not easy to get gear picked up and sometimes feel like you bother them if they even pick it up.

to clarify gear is put in travel bag to help restrict contamination, and all fire related clothing has always kept away from other family clothing and done separately with extra rinses.

Many points you mentioned.

education of ff concerning safety, prevention, and benefits pertaining cancer and causes and tx

After being diagnosed with cancer, not having to fight and prove that it is work related.

The apparatus exhaust removal system does not exist. Not just us getting in and then starting. What do we do when our air does not build up for 3 min so we have to leave it running in the bay before we leave. Also our living quarters is just a leaky door away from the bay. No Decon room at my hall either.

rinsing off PPE at a fire scene may not be practical during all weather conditions; so to remove used gear (bagging and storing) might work, but temp. exposure to wet clothes underneath would have to be addressed. wet PPE is still warmer than wet uniform clothes. not all apparatus has working heaters. and what about the potential of responding to another call while en-route to the hall? 2 sets of gear (on board) could solve problem, now its a storage issue, who's got room on their equipment for 2 sets of gear? maybe hand and face sanitizer, disposable towels and fresh glove/hoodie replacements available at every fire scene could reduce secondary exposure. soiled gloves and hoodies exchanged for clean, then the soiled are bagged/washed and redistributed.

Purchasing Nomex/Flash Hoods that filter 99% of particles known to cause cancer. Why did I have to buy My own? I used to smell like smoke after the fire, but since using my knew hood....Not a hint of smoke! Also baby wipes/fire wipes that I purchased MYSELF I use to wipe down after every fire. Plus as I am an officer I have bought them for my men and make sure they wipe down.

That of Handling other FireFighters Gear

in bay monitors fail to work so does the exhaust fans. we should have exhaust hoses placed in all halls to remove any fumes and if any firefighter or medic gets cancer we should simply be covered across the board, not fight for our benefits. chiefs should stay out of fires unless required for safety or command and instead be directing the men from outside and mandating all personnel wear mask.

Not sure how to answer this question to be honest.

mandate cleaning procedures

Total bay exhaust system put in all fire halls with hose attachments that go onto each apparatus exhaust tip. We breathe too much carbon monoxide.

the filling out of forms in order to make IOD claims not such a fight to get approved

time out of service after a fire to properly decon and shower!! that would ensure more people reduce their risks.

Does not matter what the front line "grunts" want addressed; the administration are going to dictate an ambiguous policy that is going disqualify affected personnel in order to save money and fund projects that are low on priority list. Health and care of personnel gets an lot of talk by city leaders, but little to no action. Fodder for votes.

Ventilation in the bay. We have large openings in the bay ceiling front and back, but no fans to remove the air. Better turn around on washed turnouts after a fire. Large bags to put gear in while returning to station after a fire (not enough room in compartments for all gear).

Everyone should have a copy of the presumptive legislature issued to them or know where to access the information. The older halls need some serious attention (doors between bay and interior rooms not sealed, no exhaust fans in some to eject exhaust , paint peeling, asbestos, old duct work just to name a few things).

in hall laundry machines for bunker gear

I believe we are all aware of the danger of carcinogen exposure, but our practices which in place is a overwhelming endeavor to overcome "old school way" etc. we still have halls where bunker gear and ice maker is stored in the bay where apparatus is started everyday on runs and check off, on one hand we know the significant of the issue, but in the other hand not much of the issue is being address... smaller department in out area have for example exhaust tubing or vents allowing dangerous diesel exhaust to vent outside the facility
.
I have done a lot of research on cancer prevention. The NFD has several areas that need to be addressed. We need diesel exhaust removal systems in all stations as well as clothes washer/drier for all stations. Only new stations have the option to wash uniforms at the station. Personnel can use totes to keep fire gear in when travelling. NFD personnel are doing better wearing SCBA during overhaul but there is always room for improvement.

Mandatory washing/cleaning of gear after use on a fire scene. Complete second set of gear to include helmet and boots. Mandatory use of second set of gear after fire until proper washing/cleaning is accomplished. I would also like to see a supply system that supports the field personnel and has extra items in stock for immediate replacement of gear as needed 24/7 not just at 0800 in the morning. I would also like to see a more proactive approach to mitigating the diesel exhaust in the garage areas, especially those stations that have bedroom doors with direct access to the garage area.

good job

Measures to help firefighters better protect themselves and others from harmful carcinogens.
Just to say hope this survey helps you Chief , Captain Theodore Anderson

METRO NEEDS TO APPROVE ALL FIREFIGHTERS CLAIMS ON CANCER RELATED ILLNESS

I would like to see exhaust tubes that connect to the exhaust pipes of the fire apparatus to divert the fumes outside. Exhaust fans that actually pull fumes out of the bay. Bunker rooms need exhaust fans as well as they are a "resthaven" for the carcinogens. Older halls are contending with asbestos, peeling paint, and little or no ventilation in the kitchen with gas operated stoves and ovens. Older halls also have utility rooms with no ventilation containing the gas heating units for the building which double as a room functioning on a daily basis (i.e., laundry room, workout room). These carcinogen filled bays are right by the "watch towers" or dayroom in these halls which have little or no insulation from preventing fumes from coming into these areas.

Equipment that has air leaks and the breaks will not release so equipment has to run inside hall.

Are we looking into dog labs like CFD local #2 is doing for their members?

I would like to see all the fire halls in Nashville to be retro fitted with diesel exhaust removal system .

Find out what is causing so much of it

automatic exposure reports for fire personell and recognition that firefighters are exposed every shift

that any cancer , no matter what it is, be automatically IOD, that you contracted it at work, period.
Set up a mass decon on scene of fires whereas while still in bunker clothes someone sprays us off with a cleaning agent and rinses us with a booster before we get back on our equipment. Also clean the airpacks before going back on the engine.

A hood exchange at each working fire offered to those who choose to participate. Wet wipes at the scene of working fires to remove sweat and soot from body. Technology on the scene of working fires to ascertain off gassing elements to influence how long we should stay masked and on air while overhauling.

Appendix C
EMS Section Questionnaire – With Answers

Hello, please take a moment to complete this questionnaire in an effort to help gather research materials aimed at reducing exposure to carcinogens. All responses are strictly confidential and can only be seen by me. Furthermore, by clicking on the link, I can only view responses and will not be able to see specific individual responses. Please be as honest as possible but remember the goal of my research is to gather valuable information to help reduce firefighter and emergency responder cancer, not bash the department. Your input is valuable to helping establish ways to keep our personnel safe and healthy.

On fire scenes, have you ever staged or worked in an area where you breathed smoke, possibly because of wind changes or a temperature inversion? Yes 85 (95.5%) No 4 (4.5%)

Have you transported a firefighter from a fire scene who was wearing turnout gear, even just bunker pants? Yes 62 (68.9%) No 28 (31.1%)

Do you wear gloves when you check the vitals of firefighters during medical monitoring? Yes 79 (87.8%) No 11 (12.2%)

Do you have a separate sphygmomanometer (blood pressure cuff) that is used only for medical monitoring on fire scenes? Yes 8 (8.9%) No 82 (91.1%)

Do you think the air around hospital ED receiving areas is safe to breath? Yes 27 (30.3%) No 62 (69.7%)

Please explain

Most have ok ventilation, part of it depends on the number of idling trucks.

The majority of patients we transport have some type of illness, whether it be contagious or not. Isolation precautions are taken during transport....by most units. That being said, the ED itself is a petri dish of all kinds of organisms, most of which we are not aware. Therefore, I don't believe the air is safe to breathe.....by anyone.

diesel exhaust. fans would help.

I sometimes hold my breath in the ambulance canopy due to strong smells of diesel from multiple apparatus.

Diesel fumes present

The ambulances are always on, thus allowing exhaust fumes to build

While units are running I believe that areas surrounding the entrance to them at the ED is a contamination factor. There should be other parking areas away from the ED entrance.

They are typically closed off areas w truck fumes
On a busy night, the ambulance bays are full of diesel exhaust in the air.

Flu season is the only thing I can think of now.

as soon as you walk out the doors of the ed's all you smell is exhaust.

Most entrances are in an open area that open up to the street and keep the air flowing. vandy and Vandy peds have a large fan that blows away from the ER to try and ensure no fumes enter the doorways..

to many vehicles idleing

most crews do not turn their ambulances off.

ambulances and other vehicles are running in a small area with limited air flow

The fumes from running ambulances is not all that safe.

Fumes from the ambulances are strong especially at busy times

Old units from other services exhaust

It depends on location, weather conditions, and number of vehicles present Poor air circulation and excessive exhaust

Most are in open air areas and not inside a garage. The wind generally moves the fumes away, however when you have multiple units in the same area the smell is stronger and heavy fumes are present.

They are working on it by making the hospital parking lots smoke free, but that doesn't count diesel apparatus idling and those exhaust fumes.

Diesel fumes.

Multiple Diesel engines running under a canopy. In ERs where helipad is close to entrance- (st Thomas west, skyline) when helicopters land/take off, rotor wash comes toward entrance and odor of fuel is strong

Diesel fumes

Lots of diesel exahust

Because its still the exhaust that's being burned just like a car's exhaust

No it is filled with diesel exhaust fumes from the ambulances and who knows what from the hospital.
Ambulance engine exhaust is very concentrated in these areas due to canopies and lack of fans to push the air.

Most are under cover and don't always have sufficient air movement to move fumes out.

ambulances exhaust under the canopy.when you open the side door of ambulance door,other ambulance exhaust are right there by your step.also ive breathed fire smoke on scene causing me to have asthma attack and I believe I was seen at e.d for possible smoke inhalation.

It is as safe as any other areas. Diesel exhaust fumes are everywhere.

Ambulances running blowing fumes in around the receiving area cannot be healthy

No ventilation in these areas other than being "open air". Carcinogens from exhaust and smog in the general area can settle and when the ER doors are opened they act as a vacume

Multiple pieces of apparatus running in the confined area of the ED Ambulance parking causes extensive exhaust fumes at times, especially if not windy.

units are usually parked under covered areas and trucks are not shut off. Fumes are contained under those covered areas.

Most of the ER's have some sort of partially covered area, even though open air you can still smell the exhaust.

Some times the fumes from gas and diesel engines is very strong

High concentration of ambulance exhaust in a small area.

sometimes but using the Def fluid helps

It is a rule that the med unit must remain on while removing or loading patient at ED. The exhaust fumes are always smelled when removing and loading patients.

Smell of diesel at ambulances bays are stronger at some ED's than others. This depending on amount of ambulances that are present.

Diesel exhaust mostly but most are ventilated well.

Most hospital ED receiving areas are usually overcrowded with units sitting in idle or high idle. Ventilation is not sufficient due to walls, canopies, or close proximity parking of units.

Ambulances constantly running and the older, mostly private services have terrible exhaust fumes.

Some outside agencies do not have exhaust filter systems on their equipment
ambulance fumes

No way around the constant traffic of diesel vehicles (often older units with visible exhaust smoke) and ems units park under an awning. All ER's are partially shielded from fresh air or a draft and Vandy adult and children's ER's are virtually enclosed. The VA does have a sign asking that crews turn off their units but this, often times, is not the case and isn't always appropriate as certain functions or accessories need to remain on even after the unit has arrived at the ER.

Diesel exhaust

When several trucks are present, the air thickens with CO

Most of the receiving areas are open and have a free flow of air

all open air areas

very strong smell of exhaust fumes at most er and very strong smell of exhaust in all bays of our stations and sometimes even in the common areas and bedrooms.

Too many idling ambulances

Please rate hospitals for diesel exhaust fumes? (choose 1 to 5, with 5 being the highest level of fumes in the receiving area)

Hospitals/ Rate	(1)	(2)	(3)	(4)	(5)
Vanderbilt ED	5	18	22	20	24
Vanderbilt Peds	5	14	21	20	28
Skyline	11	29	24	14	8
Centennial	12	25	24	21	6
VA	18	31	23	12	5
Southern Hills	10	34	29	10	3
Saint Thomas Midtown	12	23	24	21	9
Saint Thomas West	14	27	30	14	4
Summit	17	31	27	6	4

After working a fire scene have you ever smelled smoke while taking a shower?
No– 25 (28.1%)
Yes in the first shower– 59 (66.3%)
Yes for two or more showers– 5 (5.6%)

Has your husband, wife, significant other, or children ever told you that you smell like fire or smoke after getting home, following a shift? Yes 58 (65.2%) No 31 (34.8%)

Is any of your PPE or Medical gear stored in the same location as firefighter's turnout gear?
Yes 46 (51.1%) No 44 (48.9%)

Do you take a shower after working on fire scenes or get back in service and work the rest of your shift?
Yes, shower after fire scene operations– 3 (3.3%)
No, back in service running calls– 87 (96.7%)

Are you aware that smoke and particulates from fire have been found to be carcinogenic?
Yes 84 (93.3%) No 6 (6.7%)

Are you aware that soot, the black stuff associated with wood fires has been found to be carcinogenic? Yes 79 (87.8%) No 11 (12.2%)

Are there areas in the fire halls that you think are contaminated by fire byproducts?
Yes 73 (82%) No 16 (18%)

If so, what areas do you believe to be contaminated?
Bunker room (3)
Turnout gear room (2)
bunker room (2)
Bay, day room, kitchen, bathroom and showers, bedroom...all most all of the hall
Bunker room and fire equipment
Bay, turnout gear room
sitting areas, eating areas, sleeping areas.....
firefighter turnouts. Isn't this normal?
Turnout rooms
Bay Area, living quarters due to not thoroughly cleaning the interior of the Fire equipment after an active fire so on subsequent calls the soot is picked up on uniforms
Where turnout is stored
Bay and Furniture
Engines. Turnout racks
Bay storage areas
Firefighters wearing their turnouts within the living area. Open bays without separate spaces for gear.
Entire hall, Exhaust from apparatus blows into bedroom while building air pressure. Bunker gear room not vented outside vents to bay. Personnel bringing gear into living quarters. Apparatus bay not vented to outside.
spare Turn out area
any room where turn out gear is stored
locker room, turnout gear room, medical supplies room
Gear storage areas and inside apparatus
where the firefighter1s hang their turnout`s
Bunk room, wash room or any other room materials or tools used in on a fire scene.
Day room
Bay, gear room,
Shelving where gear is kept, all seats that are not wiped down regularly, esp those with foam showing. Washing machines and dryers from washing FF clothes, esp when visibly have residue. Apparatus bays with soot stained walls and some halls with unsealed doors, or 2 doors between Bay and bedrooms.
Bunker rooms, bay area (I can walk in to work and tell if there has been a fire just by the odor of the bay area), day area after a fire, bathroom after a fire
Depending on the age of the hall, some of the older halls are 100% contaminated. Newer construction has better isolation capabilities.
Our crews clean everything after the fire and change clothes quickly after returning.
gear area and our units
Bay, gear room, washing machine
Bedrooms and gear room

bunker room, bay
The bay and turnout storage rooms
Common areas (day rooms and hallways)
some fire apparatus and gear rooms
Bay, bunker room
gear room at 23s is open after a fire you can smell in the whole bay
Gear room and the bays which are not properly ventilated
garage and bay areas. areas where turnout gear and other fire fighting equipment is stored, hallways leading into the living areas of the fire station
Generally anywhere outside of the station where personnel are operating. Have never seen bunker gear worn inside the stations
bunker room/bay
Gear storage areas, sinks, and showers
Living areas, bathrooms
areas where FF bunker gear is stored and anywhere in the hall that FFs or EMS staff who were on the fire scene may go back into the hall and sit.
where the fire turnout gear is stored
Bunker room and for a pretty good time after a fire the bay ,, from the engine and or truck
Turnout gear locations and bay area.
Bunker Gear Racks or the room wear Bunker Gear is stored.
Bunker gear room
bay, fire engine/ trucks, decon room, bunker room
turn out room where gear is stored.
bunker room vehicle bay
the bay where the turnouts are stored
storage area in the older halls some of the living quarters
Bay(Gear off gassing and not being properly cleaned or replaced with clean gear.) Turnout gear room(Fire and EMS Turnout/Jump bags stored in the same room.)
bathrooms
equipment bays(walls and air), there is no vent system to pulls air out of bays
where gear is stored
Various places... Gear, Hose, etc. are washed or placed in various places after fire calls.
turnout gear closets
The equipment bay.
All
Turn out area, and bays due to the hoses.
bunker room all seats of engines and ambulances, everywhere in the bays
Turnout storage area
gear room

Do you ensure everyone is on board prior to starting the Med Unit? Yes 35 (38.9%) No 55 (61.1%)

Have you ever submitted an exposure form for either fire scene contamination or diesel exhaust fumes with the NFD? Yes 7 (7.9%) No 82 (92.1%)

Prior to this questionnaire, have you read the Nashville Fire Department OPG on carcinogen exposure prevention? Yes 41 (46.1%) No 48 (53.9%)

Did you find the OPG adequate to address your concerns? What would you add to the NFD's carcinogen exposure prevention policy? What training, if any, do you feel would benefit you in regards to carcinogen exposure prevention?
yes (3)
N/A (2)
Nothing (2)
No, because some of the policies are not ablate be followed.
Nothing

Although I have not read that OPG as yet, I will address it soon. EMS personnel are required to be up close and personal on the fire grounds, with cot and equipment. We are not required to wear face masks and tanks. Therefore, we breathe smoke freely because there is no protection, which is a concern. We are exposed through skin and air to any carcinogens floating around.
adequate
Yes, maybe exhaust tubes in the halls
Na
No idea
i have not read it....
I find it adequate
NA
Yes.
It was okay
Not read yet
Not completely.
N/a
No ems specific plans for decontamination after fire operations
Got denied my cancer claim because ASC rep said "you're not a firefighter". We are either Fire Dept. or we are not. Breathing the same fumes you guys do..
new halls has on room with filter system old halls are open to other areas and not confined
Should be mandatory that all apparatus be pulled out to perform morning check offs or if inclement weather, ALL doors be lifted entirely prior to starting apparatus
have not read it or at least have not read it in a while
n/a
allowing EMS time to decon themselves like FFs do. It does not seem to be a priority on the EMS side.
Yes
nothing
Have not read
Found Adequate
not read it
Yes, But honestly I believe other departments with vac systems in the bay like many other progressive fire departments around the country.
na
yes. I do not believe there has been enough studies done to fully have sufficient OPGs in place.
Seems well written
yes
never read it

What training, if any, do you feel would benefit you in regards to carcinogen exposure prevention?

N/A (3)
not sure (2)
Better educations regarding running equipment inside buildings.
How to decrease the likelihood of coming in contact with theses products. We also need exhaust systems in the bay .
Special mention in our inservices would be a good start.
include in inservice
More information at in services and practical implication.
Information that specifically designates exposure control for decreased contamination
Inservice would be good
None... unavoidable job hazard
In service on the dangers of diesel and fire scenes
safe distances...As EMS I feel we need to be close enough to be able to treat a patient or member of NFD during a fire if needed, but I am curiousas to how close is close enough? is there a safe distance where the air is saturated enough for us not to worry??
none
NA
More dedicated training to current practices, which changed could be reduce exposure.
to use scba on fire scene`s when needed
Maybe an in-service for personnel to be made aware of exposures and how to best limit exposure.
Any training helps
Fire ground EMS operations (all encompassing) outlining the do's and don'ts. Training to suppression to shed gear prior entering ambulances if assisting in care.
All halls should have better exhaust fans (ones that work) and better ventilation for bay areas.

More awareness (entry level training) and to have upper level management be involved in the training as well.
None. We have to keep an eye on the fireman which means we'll be close by to the fire.
We were trained in the academy but you cant get away from most of it
n/a
Same training the fire side gets.
training is good,but what good is it if turnout rooms are opened to other areas and have to smell it
None
don't know
More training geared toward EMS aspect of prevention
It would probably be helpful to have training on making sure that we are bring contaminated fire gear into the ambulance.
Mandatory reading of OPG and literature about carcinogens.
I believe we have plenty of Training, Personal just need to put in practice their knowledge of what they know about carcinogen.
just common knowledge training
Going over the form in detail, enforcing safety regulations already put in action. Education on what forms to fill out with regarding to being exposed to such events.
how EMS should properly clean effectively and maintain our standards of running other calls.
I don't believe just training fixes the problem. awareness and being proactive as a team is what would solve the issue. just because everyone is trained doesn't mean they act upon the training.
lecture/education on the byproducts of smoke from fire scene
Education on the effects of not cleaning gear, SCBA's, medical equipment after exposure to carcinogen's. Absorption percentages related to parts of the body. Proper cleaning of gear and equipment.
An annual reminder of when, where & how we are exposed to carcinogens.
Any
none cause metro wont change or due anything about it

Do you know/understand what current cancer presumption legislation protects you as an emergency responder with the NFD EMS division? Yes 72 (80.9%) No 17 (19.1%)

How concerned are you that past practices you have participated in may cause you to be diagnosed with cancer at some point in your lifetime?
Very concerned– 33 (36.7%)
Somewhat concerned– 31 (34.4%)
Only concerned when the subject is brought up– 14 (15.6%)
I seldom think about it– 10 (11.1%)
It does not concern me at all– 2 (2.2%)

Appendix D
Outside Fire Department Officers Questionnaire–With Answers

Hello, my name is Hugh Wingett, and I work as an Incident Safety Chief for the Nashville Fire Department. I am researching how to reduce carcinogen exposure of our department's personnel. Please take a few minutes to complete the questionnaire to assist me in my research. If your department has a policy in place for carcinogen reduction and you are able to share, please email it to me at hugh.wingett@nashville.gov. Thank you in advance for any help you can provide for me and my department.

Does your department have a policy that addresses carcinogen exposure? Yes 21 (31.3%)
No 46 (68.7%)

If it does not, does you department address carcinogen exposure issues in other department policies such as decontamination, PPE, Vehicle exhaust in the station bay, etc.?
Yes 38 (57.6%) No 12 (18.2%) We, have a carcinogen exposure policy 16 (24.2%)

Does your department employ active or passive measures to reduce carcinogen exposure? -An example of active measures is washing fire gear after every fire and/or exchanging gear, installing exhaust removal systems, or providing cancer hoods, etc. -Passive measures would include having policy in place that advises personnel to be seated in the apparatus with bay doors open prior to starting engine, instructing personnel on how to clean their own gear, or recommending them not to take contaminated station uniforms home.
Yes, Active– 22 (32.8%)
Yes, Passive– 6 (9%)
Both active and passive– 34 (50.7%)
No our department currently does not formally address carcinogen reduction/avoidance.– 5 (7.5%)

Does your department train its members in how to reduce their exposure to carcinogens?
Yes 47 (70.1%) No 20 (29.9%)

If a member of your department is injured at a fire or has a medical emergency, are they decontaminated or have their bunker gear/PPE removed prior to transport?
Yes 39 (58.2%) No 28 (41.8%)

Does your department have a hood exchange program? Yes 37 (55.2%) No 30 (44.8%)

Does your department have a laundry service for station uniforms or offer a station washer and dryer?
Yes, we have a laundry service– 9 (13.4%)
Yes, we have station washer and dryers– 52 (77.6%)
No, our members clean their own uniforms away from work– 6 (9%)

Are your personnel's fire helmets clean, or are dirty helmets viewed as badges of honor reflecting firefighter toughness?
Clean is the expectation Yes 48 No 19
Dirty is the reality Yes 37 No 26

Does your department practice on scene, post fire, gross decontamination? (Gross decon using wash, brush, and rinse)
Yes, prior to face piece removal– 7 (10.4%)
Yes, post face piece removal– 14 (20.9%)
No, we do hose off with a booster or garden hose on scene– 18 (26.9%)
No, we do hose off our gear back at the station– 13 (19.4%)
No decon or rinse takes place– 15 (22.4%)

Are crews placed out of service for any length of time after a fire response to decontaminate gear and shower? Yes 20 (30.3%) No 46 (69.7%)

Does your department have dedicated incident safety officers? Yes 32 (47.8%) No 35 (52.2%)

Do your members wear SCBA during _____?
Overhaul Yes 63 No 4
Car fires Yes 62 No 5
Dumpster fires Yes 60 No 7

What is the penalty for not wearing SCBA during overhaul, dumpster fires, car fires, etc.?
None (10)
Progressive discipline (3)
Verbal warning (2)
none (2)
Written reprimand or worse
Progressive Discipline
No set policy on discipline.
Officer verbal warning
Nothing
Varies, not consistent
Safety Violation / disciplinary step one
None captain digression
Write up/ suspension/ termination
Repeated offenses, you can be terminated
There is none.
Company officer will ensure this is done. If it is not, disciplinary action can be utilized.
Hasn't happened, but we'd discipline the officer
Possible reprimand
The IC or Safety Officer make sthem do it.
not sure there is a penalty
Written reprimand
Progessive disciplinary action
Training and Discipline
M/A
No real penalty.
progressive discipline starting with a written reprimand

Coaching (Training documentation - 1st offense
Write up, next step would be a suspension
Warning verbal
Progress Reprimand
The use of progressive discipline.
Verbal Counseling
Usually training, but we have written people up in the past as well.
None, Talked to.
oral reprimand
Progressive discipline
Addressed in department policy / directives
Not really
Immediate supervisor handles on case by case
Progressive Discipline
Escalating Discipline
remedial training, continued behavior may result in written reprimand
Standard progressive disciplinary process. Hopefully, our training program and pre-defined supervisory expectations eliminate this concern. We have not experienced any deficiencies in this expectation.
documented supervisor report and verbal warning for first offense
warning, oral reprimand, written reprimand
No penalty
Counselling
Removed and instructed to get proper PPE on
DIscipline under our dept. policy for insuboordination
Counselling, does not happen
Documented disciplinary action.

Do your members fill out any kind of exposure paper work after each fire to establish an exposure history? Yes 14 (20.9%) No 53 (79.1%)

Do your members ride in their apparatus with dirty or contaminated fire gear in the cab? Yes 54 (81.8%) No 12 (18.2%)

Do your department members get a yearly medical screening? Yes 38 (56.7%) No 29 (43.3%)

Does your equipment carry decontamination items such as wet wipes and/or soap to wash the areas of the face, neck, and hands after fires? Yes 45 (67.2%) No 22 (32.8%)

Does your department use extractors to wash turnout gear? Yes 60 (89.6%) No 7 (10.4%)

Does your department wash turnout gear after every fire? Yes 42 (62.7%) No 25 (37.3%)

Do you have two sets of turnout gear for each department member? Yes 26 (39.4%) No 40 (60.6%)

Does your department have diesel exhaust removal systems in its stations? Yes 44 (65.7%) No 17 (25.4%) We are in the process of getting them for our stations 6 (9%)

Appendix E
Personal Observational Data Form of Fire Recruits
Tallied for the month of February 2018
Location: Nashville Fire Training Academy

Date_____ Time_____ Activity_____

Inhalation

Exposure Type	Training	Attributing Factors
Doffing Exposure	**34**	
Cntd. bunker no mask	**34**	
Hot Zone exp. no mask	**0**	
Cross Cntd. exposure	**0**	
Dirty gear transport	**0**	
Dirty gear living area	**34**	**Plus instructors five days a week**
Diesel Exhaust	**0**	

Comments_____

Ingestion

Eating/smoke/dip scene	**0**	
Eat/smoke/dip shift change	**0**	

Comments_____
_____

Dermal

Fire Exposure in Gear	**34**	
Soot on skin	**8**	
Handel Cntd. Gear	**34**	
Wear Cont. gear	**34**	

Comments_____
_____

Injection

Cuts on fire scenes	**0**	

Comments_____
_____

Best Practice Standards Observed That Reduced Carcinogen Exposures

_____
_____
_____

Observations Made from February 01, 2018 through February 28, 2018

Training Layouts	Total Exposures	Direct Exposures	Indirect Exposures
5 evolutions 34 students, 5 instructors	**39**	**39**	**34 daily x 13 days exposed to contaminated gear.**
Inhalation	Ingestion	Dermal	Injection
39	**0**	**39**	**0**

Appendix F
NASHVILLE FIRE DEPARTMENT
OPERATIONAL PROCEDURES AND GUIDELINES (DRAFT)

CHAPTER – ADMINISTRATION

EFFECTIVE: April xx, 2018

Approved:	**RESCINDS:**	**AMENDS:**	**REFERENCE:**
WS (SIG. ON FILE)	**EXISTING DEPT.**		**NFD OPG**
	MEMOS & POLICIES		**1.46, 2.1, 2.17, 5.1 6.4**

Section:1.XX Carcinogen Exposure Avoidance & Prevention

PURPOSE
To establish Operational Procedures and Guidelines (OPG's) that will assist the Nashville Fire Department and its members in Cancer Prevention and Best Practices in the Reduction of Exposures to Cancer causing Agents.

SCOPE
This OPG shall pertain to all probationary, non-civil service, and civil service employees of the Nashville Fire Department (NFD). This OPG will be consistent with current Civil Service Policies Section 6.1 Employee Conduct in General.

AUTHORITY
As authorized by the Director Chief, Nashville Fire Department.

GENERAL INFORMATION
Cancer is one of the ***leading*** causes of death among firefighters today**,** following cardiovascular disease, as determined by numerous scientific studies and data collections which have been evaluated by the National Institute for Occupational Safety and Health (NIOSH) and by the International Association of Fire Fighter's (IAFF) Line of Duty Deaths Database. Cancer deaths among members of the fire service have risen dramatically over the last 20 years, in conjunction with the increasing toxicity of modern fires and because of synthetic products, plastics, and other toxic chemicals that release carcinogenic by-products when burned.

SPECIFIC INFORMATION
The primary exposure routes for carcinogenic by-products are:

1. Inhalation – During the response if the SCBA is not in place and after the fire from off-gassings equipment.
2. Dermal–During the response due to penetration of contaminants through gear.

3. Ingestion – Contaminates entering the mouth due to eating/smoking/using smokeless tobacco with dirty/contaminated hands.

*****NOTE*** All fire scene Officers are employed to ensure that all fire personnel engaged in fire suppression or fire overhaul operations will maintain the donning of their SCBA and Face piece while actively engaged or until such time as the Incident Commander or their designee determines that a safe atmosphere exist and SCBA and Face piece may be removed.**

DEFINITIONS

Best Practices – Method or technique that identifies a standard way of doing something that multiple organizations can use and adopt. Typically these methods have been tried, researched thoroughly and been found to be very efficient and practical.

Carcinogens – A substance or agent that can cause cells to become cancerous by altering their genetic structure so that they multiply continuously and become malignant.

Dirty Zone (Red) – A designated area in the station for contaminated equipment including SCBA, EMS Equipment, fire hose, bunker clothes, etc., that should be cleaned.

Intermediate Zone (Yellow) – This area is typically the apparatus bay.

Clean Zone (Green) – This is the living quarters: i.e. (bedrooms, kitchens, offices, sleeping quarters, workout rooms, main lobby, etc.). These areas must be free as much as possible of any type of contaminated items.

Cross Contamination – The process by which bacteria, other microorganisms, chemical toxins, and carcinogens are unintentionally transferred from one substance or object to another, with harmful effect.

PROCEDURES

In order to promote the safety of firefighting personnel Incident Command should be established as early as possible. The incident commander (IC) will determine the overall strategy, Offensive or Defensive based on the IC's risk assessment and established risk profile.

Risk Profile

We May Risk Our Lives a Lot to Protect Savable Lives
We May Risk Our Lives a Little to Protect Savable Property
We Will Not Risk Our Lives at All to Save What is Already Lost

Due to the inherent hazards associated with the fire or incident scene, efforts must be made by Command to limit the number of personnel on the fire ground to those assigned to a necessary function.

All personnel shall be as outlined in OPG 4.14:

In staging awaiting assignment.
Assigned to a task or operating in a sector.
In rehabilitation and medical monitoring.

***Note–once an assignment is complete, crews are to report back to command assignment complete and return to staging or proceed to rehab. Working on a scene without an assignment is freelancing and will not be tolerated.

Hazard Control Zones

Hazard control zones shall be established for the purpose of minimizing confusion and limiting the number of personnel exposed to fireground hazards to only those necessary to successfully control the operation. These zones shall consist of Hot, Warm, and Cold.

Hot Zone

The Hot Zone will be defined as any area that requires SCBA, charged hoseline, special protective clothing, or in which firefighting personnel are at risk of becoming lost, trapped or injured by the environment or structure. **All Firefighters working in the Hot Zone shall be in crews of two or more wearing full PPE to include SCBA and face piece and have an assignment.**

Warm Zone

The Warm Zone will be defined as just outside of the Hot Zone where firefighters are not at risk of becoming lost, trapped, or injured by the environment or structure. Functions inside this zone include; Decontamination, forward work apparatus engines with lines laid on trucks with equipment and ladders in use, RIT staging, Accountability officer, and Safety.

Cold Zone

The Cold Zone will be defined as outside the Warm Zone where no one is at risk because of the incident. Functions in this area include; command, staging, support and staff personnel, rehabilitation, medical monitoring, PIO.

On Scene Gross Decontamination

On scene gross decontamination will be conducted for all members exiting the Hot Zone. If air reserves permit a wash, brush, and rinse will occur prior to doffing the face piece. In the event the mask must be doffed prior to a wash, brush, rinse decontamination due to low air, effort should be made to remove the SCBA pack, doff the fire coat, push the hood down the high pressure line away from the mask and then doff the face piece with the mask still flowing.

For extended alarms requiring reentry firefighters should doff turnout coats and hoods prior to removing their face piece in order to reduce their exposure to off gassing contaminates from their coats and hoods.

Once operations has progressed to taking up equipment, all gear and equipment should be decontaminated prior to loading back on the apparatus. PPE should be bagged and placed in an outside compartment to be transported back to the station.

Rehabilitation and Medical Monitoring
EMS personnel will set up an area upwind from the incident in the Cold Zone to conduct medical monitoring and rehabilitation. All firefighters shall be decontaminated and have their SCBA packs, coats, hoods, and helmets doffed inside this area. Personal decontamination will begin in this area with wet wipes used to remove contaminates from the face, neck and hands.

Personal Decontamination Time
Upon termination of command all units should proceed directly back to their stations to shower and put on a clean uniform. Bagged up gear will be placed in the station's dirty or red zone to be picked up by Logistics to be laundered. The second set of turnouts will be placed into ready status on the apparatus and the company will return to service within thirty minutes of command termination.

Decontamination Completion
Once back in service the company should continue to decontaminate gear more thoroughly such as SCBA packs, Boots, Face Pieces, Personal Tools, Flashlights, and the Inside of the Apparatus Cab. PPE will be decontaminated in the dirty or red zone. In addition all station uniforms and undergarments should be laundered using the station's washer and dryer as contaminated clothing should never be taken home. NOTE at no time should bunker gear ever be in any clean or green zone areas "living areas" of the fire station!

Training Burns
When incumbents or recruits participate in class A training burns all members will observe the above listed best practices as if they had responded to an actual fire incident.

Documentation
Any time a member has been in the HOT Zone or has been contaminated at a fire scene in the Warm Zone or Cold Zone due to wind shifts, temperature inversions, or cross contamination the incident is to be documented using the NFD exposure form as well as documented in the narrative of the NFIRS report.

Diesel Exhaust
Until such time that the NFD can invest in diesel exhaust source capturing systems all NFD vehicle operators shall observe the following measures to limit the exposure to vehicle exhaust:

- Always open bay/garage door(s) before starting any unit(s).
- Do not allow vehicle(s) to idle inside the station.
- All engineers/drivers should be instructed to keep vehicular operation to an absolute minimum in the fire station.
- Garage doors should be left open, when weather permits, for at least 10 minutes following the operation of the vehicles.

- Keep all doors leading from the garage to stairwells, living quarters, or other areas closed and sealed.
- Don’t start vehicle until everyone is ready for response.

ENFORCEMENT

Any members found in violation of these provisions will be held accountable by the Director Chief of the Nashville Fire Department and is subject to disciplinary action in accordance with Civil Services Policies and Procedures.