Running head: RAPID SEQUENCE SPOT SAFETY INSPECTIONS

Rapid Sequence Spot Safety Inspections: A 10 second commitment to increase the safety of Morganfield firefighters.

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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 the language, ideas, expressions, or writings of another.

Signed_____

Abstract

Morganfield Fire Department (MFD) firefighters do not have a policy to enforce, or a procedure to perform a rapid sequence spot safety inspection ensuring that PPE is deployed and functioning prior to engaging in high-risk activities associated with structural firefighting. Without such policy MFD firefighters were vulnerable to inappropriate wearing of assigned PPE which increases the potential for injury or death. The purpose of this Applied Research Project (ARP) is to create an easily identifiable and memorable rapid sequence spot safety inspection of PPE that MFD firefighters can conduct within a few seconds, where the equipment is checked before engaging in activities that have an inherent risk to life and well-being.

Research identified the following questions: What items of the PPE ensemble are identified by firefighters and fire officers as critical elements that must be visually checked prior to engaging in structural firefighting activities? What are the rapid sequence spot inspections that are used by Self-Contained Underwater Breathing Apparatus (SCUBA) instructors and US Army Airborne units? Can the inspection points provide a template for the MFD to create a procedure to conduct a rapid sequence spot safety inspection? Are there any existing acronyms or rhymes being utilized that address firefighter rapid sequence spot safety inspections? What is the acceptable time to accomplish this rapid sequence spot safety inspection?

Research was carried out by performing a literature review from various texts and journal articles, conducting an internal and external questionnaire, reviewing military and SCUBA texts and manuals, and reviewing policies and procedures from various departments across the nation. The research was found that the MFD has no policy, procedure or process in place for firefighters to rapidly inspect their PPE prior to engaging in structural firefighting activities. The recommendations include training on the inspection process, development of the inspection lesson plan, and implementing the SOG.

Table of Contents

Rapid Sequence Spot Safety Inspections: A 10 second commitment to increase the safety of Morganfield firefighters.

Introduction

Firefighting, like many occupations contains a certain degree of risk to a firefighter's individual health and well-being as a result of the high-risk activities of entering in and closing upon a fire in a structure to contain, suppress and extinguish unwanted fire. Many tactical operations such as entry, ventilation and searching for unconscious and hurt victims, increase the amount of risk and exposure to conditions which can cause detrimental effects to the firefighter. Fire suppression is generally accepted as a hazardous occupation; firefighters have accepted the abnormally high levels of risk associated with the various roles of today's modern fire service. Today's firefighter is an emergency responder of numerous disciplines, unlike their counterparts of decades past, today's firefighters still respond to various types of fires, but also respond to emergency medical calls, hazardous materials releases, specialized rescues, and numerous other service calls in the performance of their duties.

Society has romanticized the role of the firefighter for centuries; firefighters have also romanticized the risk associated with combating fire and the thought of supreme sacrifice. Modern media has produced big budget movies that detail a portion of the risk associated with firefighting, where at least one if not more firefighters will perish as a result of the risks associated with structural firefighting. As much as society, young firefighters can emulate the risky actions and activities portrayed by actors and stunt personnel in these mediums and establish poor safety habits, or establish a misguiding about the glamour of the risks early in their firefighting career. The sensationalism of movies, local news media during line of duty deaths, society and its firefighters embrace the lavish arrangements of firefighter funerals.

Whole communities turn out to support the family and friends of fallen firefighters, embracing the hero in death aspect, many times firefighters attending these funerals, never question the factors surrounding the line of duty death, or the incident. The harsh reality is, firefighting is a dangerous occupation, injuries can and do occur, and the one million plus firefighters in the United States respond to structure fire incidents day after day. In 2010 United States fire departments responded to 369,500 structure fires which 87% of all firefighter injuries occur in the structure fire environment (United States Fire Administration[USFA], 2012b) (National Fire Protection Association [NFPA], 2011). This data identified that a structure fire occurs in the United States every 59 seconds (USFA, 2012b), the emphasis of the last thirty years has been a stronger prominence on fire prevention, early detection, notification, and rapid extinguishment which resulted in a deduction in the number of fires in the United States.

The United States fire service, even with the reduction in the number of fires, continually averages 100 firefighter fatalities and approximately 100,000 firefighter injuries annually over the last thirty years (USFA, 2012a). The alarming number of these injuries and deaths are associated with structural firefighting, firefighters are 13 times more prone to injury and death in this environment as compared to all other hazards associated across the broad spectrum of emergency response incidents (USFA, 2012a). Behind strains and sprains, burns are the second leading cause of firefighter injuries and death in structure fires. Firefighters with the Morganfield Fire Department (MFD) continually follow detailed checklists that require Personal Protective Equipment (PPE) safety inspections during high-risk activities such as specialized rescues, hazardous materials releases, and the required inspections of National Fire Protection Association (NFPA) 1403 prior to conducting controlled live fire training scenarios.

The problem is the MFD does not have a policy to enforce, or a procedure to perform a

rapid sequence spot safety inspection ensuring that all vital components of the PPE ensemble is deployed and functioning prior to engaging in the high-risk activities of structural firefighting. The purpose of this research is to create an easily identifiable and memorable rapid sequence spot safety inspection of PPE that MFD firefighters can be conduct within a matter of a few seconds, where the equipment is checked before engaging in activities that have an inherent risk to life and well-being. Action research was utilized to create a template, lesson plan, policy and process to conduct a rapid sequence spot safety inspection to verify that MFD firefighters wear the assigned PPE properly to limit the potential for an injury or fatality.

The research will address the following questions: What items of the PPE ensemble are identified by firefighters and fire officers as critical elements that must be visually checked prior to engaging in structural firefighting activities? What are the rapid sequence spot inspections that are used by Self-Contained Underwater Breathing Apparatus (SCUBA) instructors and US Army Airborne units? Can the inspection points provide a template for the MFD to create a procedure to conduct a rapid sequence spot safety inspection? Are there any existing acronyms or rhymes being utilized that address firefighter rapid sequence spot safety inspections? What is the acceptable time to accomplish this rapid sequence spot safety inspection?

Background and Significance

Morganfield is a unique diversified community in Western Kentucky located approximately 30 miles southwest of Evansville, Indiana; Morganfield is considered part of the tri-state area comprising Indiana, Illinois and Kentucky. The city is considered a bedroom community, as many of our residents work outside of the community but return at night. The city was founded in 1811, as a meeting point of two major trade trails and the easy access to the

Ohio River. The two trade routes later became state highways that provide direct routes to access southern Illinois and northern parts of Kentucky and Southern Indiana.

The close proximity of the Ohio River, the area was prominently known for its agricultural base, and early river vessels ensured that products were easily shipped throughout the Midwest. Morganfield was incorporated in 1842, is one of the oldest cities in western Kentucky and is the county seat for Union County. The fire department was established as an un-organized volunteer force in 1824, and hired its first full-time employees in 1897. The MFD provides fire protection to the city of Morganfield and the United States (US) Department of Labor Earle C. Clemet's Job Corps Center.

The MFD is a full-service combination fire department comprised of eight career employees and a volunteer force of 20 members. The department provides a wide array of services including fire prevention duties, emergency medical response, specialized rescue, requiring all members of the department maintain certification as firefighters through the Kentucky Fire Commission. Numerous volunteers and all career personnel are trained as Emergency Medical Responders or Emergency Medical Technicians, all career personnel are certified instructors, and two are certified fire inspectors. The total service area is 3 square miles with a population of 3,285 (US CENSUS, 2010) residents in the city, and according to the housing director, the US DOL houses 1,322 Job Corps students on the second largest facility of the Job Corps in the United States.

The department operates three apparatus and one command vehicle from one station located in the historic downtown district, and affords many modern firefighting practices and technologies to a small town. The mainstay of the local community is largely designed to support agricultural and mining operations, the agriculture business has always been the mainstay of

Union County, in the late 1890's coal was discovered in the county. There are numerous coal mines in Union County, with four operational mines in the city limits. The city and the ten blocks of the down town area were rebuilt after Morganfield was destroyed by fire at the hands of the Union Army in 1863.

Many of these structures were built in a period from 1870 to 1885, and share common features such as heavy timber construction, brick facades and a lack of fire detection and suppression systems, which create additional hazards to the Morganfield firefighters. The fire department and the Union County School District share a respected and established relationship to ensure the safety of over 2000 students who are educated at the Morganfield elementary school, and the county wide middle and high school, all are located in city limits. The make-up of the rest of the community currently includes several large box style stores, numerous restaurants, large scale manufacturing operations, the county hospital and two long term nursing care facilities. While the Department of Labor Job Corps and mining operations provide substantial jobs for local residents, many commute to other larger communities over 25 miles away creating the bedroom community.

The department provides critical infrastructure protection including many county, state and Federal Agencies including the US Department of Labor Job Corps Center, the US Department of Agriculture and US Mine Safety to name a few. The unique spread of occupations, close proximity to both state and federal wildlife refuges, ample lodging including camping sites within the city, and dining and essential services establishes the community as a foothold for the "little Sturgis motorcycle rally" and the annual gathering of the "Juggalos". The population of the community can grow to 40,000 people during the third weekend in July and the second weekend of August, increasing the number of calls for service, vehicle accidents and the

increased potential for fire related civilian injuries due to the cramped and transient nature that is common at camping and hotel locations. During 2011 the MFD responded to a total of 341 calls for service, in which 6% or 19 calls were for fires within a residential structure (Morganfield, 2012).

The City of Morganfield is not a heavily populated urban sprawl, or a majorly packed suburban community, it is classified by many as a small town; although the same hazards to firefighters are present in Morganfield as their firefighter counterparts' face in the larger communities. A problem associated with the size and demographics of the City of Morganfield is that MFD firefighters are not continually exposed to structure fires to maintain their individual skill set or their situational awareness of all the hazards associated with structural firefighting. The MFD has experienced injuries related to the tasks that firefighters must accomplish while extinguishing fires within a structure, the department further identified that appropriate PPE and its use will reduce the severity of these injuries prior to 2011. The department continually inspects for service and maintains the firefighter PPE ensemble utilized in structural firefighting during cleaning and laundering of the ensemble.

Two career firefighters suffered first and second degree burns on an incident in 2011 while searching a mobile home for missing occupants while providing mutual aid to a county fire department. Firefighters were provided first aid treatment on scene, had a no lost time injury, and neither employee filed a worker's compensation claim. The department investigation was completed into the incident in order to determine what caused the injuries, it identified that both employees wore all PPE appropriately, the burns were suffered when firefighters from mutual aid agencies entered the structure from a different point and created a thermal imbalance and reversal by pushing heated gasses and smoke onto the MFD firefighters. The accident

investigation interview with the involved career firefighters indicated that they both felt that the burns they suffered were part of the job, and that because they were superficial and not full thickness or larger burns where definitive hospital care was necessary then it was a not worth the extra requirements necessary to file worker's compensation claim paperwork.

Upon further review of occupational injury reports of the MFD and prior worker's compensation claims, there have been similar reports of superficial burns in the past. However, previous administrations did not thoroughly investigate or determine the root cause of the incident and the injuries. The data from the incidents revealed that firefighters of the MFD have indicated that small burns are part of the job and that they felt they thoroughly identified and accepted the potential risk in searching for victims. One question that continually arises from data collected by the National Fire Protection Association (NFPA), United Stated Fire Administration (USFA), and information provided in the National Fire Incident Reporting System (NFIRS), is the information provided factual and accurate or are some incidents and injuries not being reported.

During a review period from 2006 and 2008 there were 87,070 reported injuries which 39,715 occurred on the fire ground (USFA, 2011). Of the fire ground injuries 65% where in structures on residential property and an additional 22% was in structures on nonresidential property (USFA, 2011). The numbers are staggering when 87% of all firefighter injuries occur on the fire ground, more astonishing is that 14% of the injuries are burns, with another 20% of the injuries a result of exposure to the hazard such as smoke and thermal energy. The proper use of PPE can play a direct role in reducing the potential for injuries from the products and by products of combustion.

Many fire service related magazines include photos, often including the cover show firefighters from various communities in the United States wearing only portions or inappropriate wearing of the PPE ensemble. These photos are just one second of an operation in which the viewer cannot determine the overall safety environment of the whole department and incident, but the numerous hours of on scene video posted to the popular social media site You Tube® also indicates that there are numerous occasions per year in which firefighters are burned or face significant potential for injuries from improper wear or use of the firefighter PPE. Does this media exposure create the mindset where inappropriate PPE use is acceptable, or does it feed the question of acceptable risk. Currently, the MFD incorporates many policies into an overall firefighter safety program, and continues to maintain its firefighters in current serviceable PPE to reduce all potential exposures the emergency responders encounter.

It does lack a specific policy on conducting a rapid sequence spot safety inspection of the PPE ensemble, and the process of how to accomplish this inspection. The emotional, physical psychological and financial toll of a line of duty death or serious injury is extremely lofty for an individual, family, organization and community to accept. The intent of this project is to create an atmosphere within the MFD where safety of the firefighters is paramount, which includes firefighters to participate and create safety theories and practices. This applied research project is directly related to the coursework of the *Executive Leadership,* R 125 course of the National Fire Academy's Executive Fire Officer Program (EFOP) (National Fire Academy [NFA], 2012).

Unit 2, Giving and Using Feedback discussed how a leader can recognize the impact of unspoken issues for leading adaptive change. The leader must understand where to start when the issue is complex that there is not a clear solution or direction to focus on for exerting influence and persuasion. This chapter also highlighted that adaptive challenges require people to alter

their assumptions, use different methods than normally used, and develop new tools and behaviors.

Unit 3, Thinking Systemically highlighted that if leaders identify the themes and utilize data they can relate this information to the fire service. This can help identify where the patterns and cycles influence human behavior and the group norms, and lead to historical perspectives influencing change within the fire service.

Unit 8, Influence described how to use persuasion to educate and involve others within the organization to align with the given point of view so that they will want to participate to obtain the same point of view. Leaders can utilize influence to get their goal accomplished. Influence is much more subtle and relies heavily on educating others to support and achieve the same goals.

Unit 11, Exercising Leadership Practicum identified where leaders influence others when presented with a situation that is adaptive in nature and that requires a decision or attitudinal change. Organizational managers will demonstrate that the influence attempt should strongly utilize a "win-win situation" for the parties involved.

Unit 12, Managing Multiple Roles highlighted that a manager organizes, coordinates, plans and controls the organization and the goal. The many roles a leader must utilize may include formal and informal roles, internal and external roles, and how an effective leader must utilize all available roles to facilitate change within the organization.

The issue of the research directly correlates to the mission of the United States Fire Administration as it directly supports USFA Strategic Initiatives goal one to "Reduce risk at the local level through prevention and mitigation". Specifically in this objective is to identify and reduce the number of line of duty deaths and injuries. Furthermore, the research supports the

USFA strategic initiative goal three to “Advocate a culture of health, fitness and behavior that enhances emergency responder safety and survival”. Finally it supports goal four “Enhance the professionalism of the Nation’s fire and emergency services leaders” (USFA, 2009).

To further support the mission of the National Fallen Firefighters Foundation, Everyone Goes Home® this research addresses the 16 Firefighter Life Safety Initiatives number one “define and advocate the need for a cultural change within the fire service relating to safety; incorporating leadership, management, supervision, accountability and personal responsibility”. It further assists in accomplishing initiative number two “Enhance the personal and organizational accountability for the health and safety throughout the fire service”. Finally the research supports initiative number four “All firefighters must be empowered to stop unsafe practices” (National Fallen Firefighters Foundation [NFFF]).

Literature Review

Personal Protective Equipment (PPE) must be used and worn in many work situations, conditions and industries in order to protect employees from harm. Hazards exist in every workplace in many different forms that can cause a variety of dangerous situations and numerous scenarios for potential injuries. Personal protective equipment (PPE) refers to the protective clothing or garments that are designed to protect the wearer’s body from injury by impact, heat, chemicals, infectious materials, electrical hazards and other job-related safety and health purposes. The equipment often includes helmets, goggles, or other specialized garments that are specifically designed to address and prevent injury from the specific hazard. The intent of PPE is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce those risks to acceptable levels.

The use of PPE is common in many industries and high-hazard occupations, some occupations or processes require mandatory use of PPE by the Occupational Safety and Health Act (OSH). The U.S. Department of Labor (USDOL), the responsible agency overseeing the Occupational Safety and Health Administration (OSHA), oversees the regulatory health and safety standards of the OSH act. OSHA identifies the requirements which workplaces must abide and sets forth safety and health conditions in most private industries that are regulated by OSHA or OSHA-approved state systems that require identical or similar standards for employers and employees (US Department of Labor [USDOL], 2012). Many employees in the nation come under OSHA jurisdiction with few exceptions such as miners, some transportation workers, many public employees, and the self-employed.

OSHA requires employers protect their employees from workplace hazards that can cause injuries; this is accomplished by controlling and minimizing the hazard. "Depending upon the hazard or workplace conditions, OSHA recommends the use of engineering or work place controls to manage or eliminate hazards" (OSHA, 2003). "Hazards exist in every workplace in many different forms: sharp edges, falling objects, flying sparks, chemicals, noise and a myriad of other potentially dangerous situations" (OSHA, 2003). When engineering, work practice and administrative controls cannot effectively eliminate and control the workplace hazard, OSHA dictates that employers must provide PPE to their employees and ensure its use.

Many public employees are mandated in particular health and safety regulations when a state approved system adopted OSHA regulations, and mining employees are covered under their own federal legislation within the USDOL (USDOL, 2012). There is a great variation in the type of equipment that may be required, as workplaces have varying mandates due to different dangers. Numerous regulations pertain to private fire brigades and are enacted by many state

OSH acts, these regulations are identified in Chapter 29, of the Code of Federal Regulations 1910.156 *Fire Brigades*.

Walters highlighted that PPE includes a variety of devices and garments such as head protection, goggles, safety glasses, face shields, ear plugs, respirators, vests, coveralls, safety shoes and gloves that protect workers (2002, p. 34). “It creates a physical barrier that travels with the worker” (Walters, 2002, p.34). The proper use of PPE by workers could prevent hundreds of deaths and thousands of injuries every year, Walters identified that despite the protections it offers, PPE has one major drawback; its effectiveness depends on people using it. The PPE of today is more convenient, comfortable and effective than ever before as manufacturers have made their products more comfortable and abandoning the traditional one-size-fits-all approach (Walters, 2002, p. 34).

Walters further stated “PPE that is not maintained properly or inspected routinely for wear and tear offers little or no protection” (2002, p. 35). “Personal protective equipment is essential for keeping front-line maintenance and engineering technicians safe on the job in institutional and commercial facilities” (Camplin, 2011, p. 34). Camplin stated that “these products can only deliver the desired protection if managers specify them properly and ensure technicians use them appropriately (2011, p. 40). Managers must identify a series of issues such as performing a hazard assessment to identify and control physical and health issues, to identify and provide appropriate PPE for employees.

As important as inspecting the workplace to identify the occupational hazard, employers must also “train employees in the use and care of PPE” (Camplin, 2011, p. 40). Health and safety professionals admit that control measures are not failsafe measures in preventing work place injuries, and PPE will continue to play a vital role in occupational safety and health

(Graveling, 2011, p.18). Graveling identified that “in many workplaces, PPE is used as an additional line of protection to supplement other control measures, or sometimes it is the only form of protection” (2011, p. 20). The selection of PPE is evaluated against a particular hazard or threat and technical standards exist to assist what would otherwise be a potential minefield.

Graveling further identified points that cause employees to not wear PPE: these include that the PPE is uncomfortable to wear, it has a tendency of getting in the way of doing the work, all of these which can cause PPE to not be worn at all (Graveling, 2011, p.19). Graveling summarized PPE is the last temporary resort in controlling risks to workplace hazards, he further stated “the use of PPE is unavoidable, and essential to the health and safety of the workforce” (2011, p. 18). The type of protective clothing depends upon the type of harmful or dangerous factors present at the worksite. Protective clothing is distinguished by its protective classification, what risk it is designed to protect the worker from (Bartkowiak, 2010, p. 26).

“Great recent progress in technology has not solved the problem of safety and protection of employees in the working environment” (Bartkowiak, 2010, p. 26). It is not possible to eliminate or reduce the dangerous and harmful factors in the workplace indicating the use of PPE is essential to the protection of employees in the workplace. The protective properties of clothing are used to constitute a barrier against dangerous factors, or to sufficiently reduce the effects of the threat so that they no longer pose a danger to the employee (Bartkowiak, 2010, p. 26). Sherrard highlighted that employees “alter PPE, use degraded items, and even try to hide broken or unusable items to avoid problems with supervision” (Sherrard, 2011, p. 46).

The author further pointed that personal protection is a lifetime security blanket for the employee and the employer, as PPE protects the employee from injury, even death and allows the employee to go home safely from another day on the job (Sherrard, 2011, p. 46). Managers

must ensure that employees understand that PPE rules are in place to help employees, not punish them. The job of managers and supervisors is to remind each employee of the hazards and ensure the safety equipment, no matter what it is or how frequently used, is worn, cared for and replaced (Sherrard, 2011, p. 46). Sherrard identified "inspections done on site in the field cannot possibly cover everything all at once, you can spot check at best" (2011, p. 47).

To accomplish these inspections the author stated that managers and employers "train supervisors and employees what to look for and how to inspect each item of PPE during field spot inspections" (Sherrard, 2011, p. 47). Checklists are important, they are not a replacement to a comprehensive safety program; checklists are used to jog the employees' memory, think outside the box and protect the employees. "During field inspections or evaluations, PPE is physically inspected for damage, proper fit, and correct use" (Sherrard, 2011, p. 48). The National Fire Protection Association (NFPA) addressed PPE in standard 1500, *Occupational Safety and Health Program*, chapter 7.1.2 states "Protective clothing and protective equipment shall be used whenever the member is exposed or potentially exposed to the hazards for which it is provided" (NFPA, 2007, p. 16).

Regulation is often passed forward to state and local levels by the enactment from legislative bodies in occupational safety acts and legislative mandates. Often the NFPA standard and OSHA regulation mirror each other or are meshed into the final draft of the legislative act. Today's Firefighter PPE ensemble is capable of providing full body protection and has been known to save lives. The text *Fundamentals of Fire Fighter Skills* identified the essential component of a firefighter's safety system is their PPE.

In enables the firefighter to survive under conditions that would otherwise result in death or injury. PPE ensembles provide specific protections so a working knowledge of its design,

applications and limitations is critical (p. 31). The text further emphasized that structural firefighting PPE ensemble provides firefighters the protection necessary to enter burning buildings and work in areas with high temperatures and concentrations of toxic gases. A structural firefighter's PPE is designed to cover every inch of the body, it provides protection from a variety of threats, and it is designed to incorporate the Self-Contained Breathing Apparatus (SCBA) which provides respiratory protection to meet the requirements of the appropriate OSH laws.

"This ensemble consists of a protective coat and trousers, a helmet, hood, gloves, boots and gloves" (NFPA, 2004, p. 34). The clothing is worn with SCBA, a personal alert safety system (PASS) device, and a portable radio. All of these elements must be worn together to provide the necessary level of protection. Firefighter's turnout or protective clothing is their PPE, it is the first line of defense when operating at emergencies, the PPE ensemble is designed to protect the firefighter from the day-to-day risks such as mechanical, thermal and biological risks (Pillsworth, 2009).

Smoke, fire, heat, blood, sharp objects and hazardous materials can cause injury or death, these risks can be minimized by utilizing PPE, although the firefighter PPE ensemble "has limitations" (Pillsworth, 2009, p. 162), it is one of many measures firefighters take to protect themselves and their partner. The *Essentials of Firefighting* discussed firefighters require the best personal protective equipment available because of the hostile environment in which they perform their duties (*Essentials*, 2003). The text further identified that providing and using quality PPE will not necessarily guarantee firefighter safety; however, injuries can be reduced and prevented if protective clothing and SCBA are used properly (2003). "Today's firefighters

have good personal protection; however, some overestimate this personal protection and take great risks at fires with serious consequences" (Dunn, 2012, p. 28).

Dunn emphasized the protection provided by PPE is overlooked as training highlights "heroic" or "high risk" activities that can turn into "freelancing" by firefighters on the fire scene. The author highlighted some fire training schools inadvertently accentuate the heroic-rescue culture and encourage firefighters to engage in risky behavior and "the fire service may unknowingly be increasing the danger to firefighters" (Dunn, 2012, p. 28). When addressing the issue of what is causing line of duty deaths, Dunn (2012,) identified that many firefighter fatality reports indicate fire service managers have given the firefighter all the protective equipment possible. "It is now necessary to analyze our firefighter tactics for the cause of the firefighter fatalities" (Dunn, 2012, p. 28).

Over the past twenty years, fire departments have staffed positions designated as Safety Officers and integrated these positions within the fire service as an effective measure to manage the safe operations of the department in all aspects from the fire station, responding to and from incidents, as well as at the incident site itself (USFA, 2008). A cautious approach as a result of Safety Officers and fire department safety programs include eliminating unnecessary risks, while continuing to perform the occupation safely and efficiently. Disabilities and deaths of firefighters should not be an expected part of the fire service, the position of the Safety Officer is to monitor, implement, and develop a safe working environment (USFA, 2008). Identified issues regarding operational safety aspects need a comprehensive strategy and action plan to address the challenges posed in safely responding to incidents, dealing with and managing the incident, and returning to the station.

Equipment use and maintenance guidelines should be developed according to the equipment manufacturer's recommendations (USFA, 2008). Safety experts have long attributed six management interventions as critical to performing safe operations.

> These include: Employee selection and hiring. Provide appropriate introductory and refresher training. Establishing, training in and enforcing safe operating procedures. Providing protective equipment as necessary. Investigating accidents and taking action to prevent reoccurrence. Avoiding the act if it places the individual in a situation where there is little or no chance of a successful outcome (USFA, 2008).

The USFA recommends departments create a supportive environment that requires dedication to health, wellness, and safety values, ensuring a culture that supports safe and healthy behaviors. In a supportive environment, employees and members believe the organization provides them with encouragement, opportunity, and rewards for safe practices (USFA, 2008). As identified in OSHA and NFPA standards, PPE is designed as a second level of protection when the hazard cannot be eliminated from the work place through engineering and other controls. In the case of the fire service, PPE is designed both to prevent injury or illness by limiting the impact of a hazard on the body, and to ensure loss reduction by lessening the impact of injury or illness when it occurs (USFA, 2008).

"As leaders, it's our job to counter resistance in order to achieve compliance" (Sendelbach, 2012, p. 12). The role to induce change falls onto the job of company officer and chief officers, although it is their responsibility to introduce change at a rate that employees can absorb. If the situation is approached too aggressively, the employees will resist in a manner that can become unmanageable. The company officer and chief officer should stand their ground, set the standard of safety and not compromise.

It is the responsibility of fire service management to keep every employee and member safe. As a supervisor, “your job is to hold people accountable” (Sendelbach, 2012, p. 12). Hyden identified that management of the modern fire and emergency service agency is basically the same as the process taught in management and administration courses (2012, p. 90). “Leading a team or encouraging the members to do what you want them to do, is complex in that it usually involves heavy interaction with your personnel and understanding their inner feelings” (Hyden, 2012, p. 90).

The author further indicated that once the objective of the organization is defined, and what the management team desires to achieve, fire service leaders “look at the resources available to achieve the goals (Hyden, 2012, p. 91). Organizational change can be difficult for many employees and managers to accept; fear or suspicion is likely to cause difficulty in achieving the desired change. Often managers and supervisors have numerous plans and objectives that increase firefighting efficiency and compliance with national and state standards, but fall short with implementation of the program. “Today, more than ever, we need to be proactive in making necessary changes within our organizations to comply with what, in some cases, may be inevitable” (Hyden, 2012, p. 91).

Fire service managers develop programs to facilitate organizational change, often the change will require the behaviors of employees and members to change. Goals and objectives should be established using the specific, measurable, attainable, realistic and timely, or SMART method. Monitoring and control is necessary to ensure compliance and alignment with the stated goals of the organization (Hyden, 2012, p. 92). Organizational change is accomplished by establishing the basic process of implementing standards, a measure of performance, comparing

the performance to standards and determining if corrective action is necessary (Hyden, 2012, p. 92).

Firefighter safety is paramount to achieve the objectives of the Life Safety Initiatives, to reduce the number of firefighter injuries and deaths. Every fire department must do what it can to reduce the hazards and dangers of the job to prevent firefighter injuries and deaths (NFPA, 2004). Fire departments and its management teams must have a strong commitment to firefighter safety with designated personnel to oversee these programs. A thorough safety plan and commitment identifies that "safety must be fully integrated into every activity, procedure and job description" (NFPA, 2004).

A comprehensive safety plan must identify each accident or injury, and investigate to learn why it happened, how the incident can be avoided in the future, and what additional safety measures must be incorporated to reduce firefighter injuries and deaths. Adequate training is essential for firefighter safety, the knowledge and skills developed during training are essential for safety. Firefighters must know how to use PPE properly and keep it maintained as poorly maintained equipment can create additional hazards to the user or fail to provide protection when needed. Manufacturers usually supply operating instructions and safety procedures (NFPA, 2004).

In *Fundamentals of Fire Fighter Skills*, the text specifically identified that before entering a burning structure to perform interior offensive operations, "firefighters must be properly equipped with approved PPE. Partners should check each other's PPE to ensure it is on and working correctly before they enter a hazardous area" (2004, p.27). Safety has become the new priority in the fire service, resulting in the creation, continual review and update of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, which provided a

template for implementing health and safety programs. The *Fundamentals of Fire Fighter Skills* further specified that Standard Operating Guidelines (SOG) and Standard Operating Procedures (SOP) are created to cover a range of items from uniforms to scene operations, these items "outline how to perform the various functions" (2004, p. 14).

The text highlighted the department safety program is only as effective as the individuals who implement it, the enforcement of SOG and SOP, and the training program as items "that are essential for fire fighter safety" (p.25). It is necessary that safety program design and implementation incorporate safe practices and policies. Policies and procedures are developed to provide a path for present or future actions, by outlining "expected performance in stated condition" (p.13). Regardless of SOP or SOG they ensure all members of the department perform a given task in the same manner, they provide a "uniform way to deal with emergency situations" (p.13).

Best (2009) identified that fire service supervisors must be conscious of safety procedures (p.37) and they must "integrate safety plans and procedures into daily and emergency activities" (p.37). Fire department training assists the department in complying with applicable state or federal Occupational Safety and Health Administration (OSHA) requirements and addresses NFPA 1500, *Fire Department Occupational Safety and Health Program* (Best, 2009, p. 31). Best further indicated that policies and procedures are used to document the "how-to" in a consistent manner so that all personnel involved understand how to accomplish it. However, he further indicated that "Regulations are legal requirements and have enforcement or compliance requirements" (p.43).

Common regulations to communicate their legal statues originate with OSHA and Department of Labor (DOL) which use regulations to communicate legal requirements (Best,

2009, p. 31). Carter identified "As a fire officer, your people are depending upon you to see that they can operate as safely as possible" (2012), indicating that fire service leaders must take up the role of shepherd for their flock of followers. The author further indicated that fire officers must understand their responsibility in returning each member home safely to their family. This critical role of the fire service leader is often overlooked the author declares by many fire officers due to their own selfish need or desire (Carter, 2012).

As a fire service leader "you cannot tolerate anything which will place your people in danger" (Carter, 2012). As the shepherd who is responsible for the safety of their flock, fire service leaders must work within the operational safety posture. Graham signified the stance of firefighter safety when addressing the risk management and identifying issues that can go wrong within an occupation or task, and creating control measures to prevent mishaps (2010). Graham identified that the firefighter PPE is a control measure, but further highlighted that "sadly there are people in your profession who suffer from arrogance, ignorance and compliancy regarding the wearing and use of PPE" (Graham, 2010).

Besides the proponents for PPE, are the firefighters alive today because they took this "control measure seriously" (Graham, 2010). The author identified that PPE is not effective when it is not used, and supervisory personnel should set the standard and wear the appropriate PPE, and ensure that their people do the same. The safety measures of PPE are ineffective in the firefighter's locker, or the trunk of the vehicle. The use of control measures are effective in minimizing the potential for an exposure to a hazard, however, there must be policy or procedure in place to enforce the use of PPE, inspections of the equipment and its use.

Hamilton identified that the "average fully equipped firefighter is provided with the proper PPE to face the hazards they encounter during any given shift" (Hamilton, 2012, p. 28).

The same is said about law enforcement officers, they are usually outfitted with a bulletproof vest, a gun, pepper spray, Taser or stun gun, baton and handcuffs to combat the hazards or threats a law enforcement office will face during their tour of duty. However, Hamilton points that situational awareness is often cited in anonymous reports as an indicator of many avoidable injuries. The author further states "situational awareness can be defined as understanding your environment and the influences affecting it now and in the future" (Hamilton, 2012, p. 29).

The United States Army (US Army) whose primary objective is facing and defeating the armed enemies of the country identified the need for PPE such as ballistic helmets and body armor, supplemented with eye protection, hearing protection, gloves to protect the hands, knee and elbow pads to protect high impact bones in the attempt to limit the number of casualties and fatalities to its soldiers during combat and training conditions. The reason behind this PPE is to maintain the war fighting mission and tempo by not suffering unnecessary injuries and deaths of controllable exposures. The immediate supervisor is responsible to identify and check each soldier has the proper equipment for the projected combat or training mission; during pre-combat operations inspection at the point of debarkation weapon systems are loaded and engaged, ballistic helmets and body armor is checked, radios turned on and tested, and final changes to the operational order are given (FM 3-21.9, 2010). The US Army redesigns and implements new PPE during and after combat operations where exposures are identified and new technology can increase the survivability of combat wounds while decreasing the number of deaths due to combat exposures.

Besides facing direct fire from enemy weapons, the US Army identified another large risk activity when deploying troops using parachutes onto the field of battle. On August 16, 1940 the US Army created the Airborne Corps and subsequently Field Manual 3-21.220 to

address the means which the US Army will deploy soldiers using this high risk maneuver to seize vital combat objectives (FM 3-21.220, 2003). The first generation of paratroopers identified that the sky was very unforgiving to the slightest mistake and early losses identified the need for a comprehensive network of additional inspections for paratroopers prior to departing the aircraft. The US Army adopted the realistic training template and designed training missions as if the trainees were conducting combat operations, or as the fire service calls train as we play.

The US Army developed Field Manual 3-21.220 *Static Line Parachuting Techniques and Tactics* to outline all applications from parachutist training, necessary safety measures to reduce injury and death potential of paratroopers, address mandatory inspections of equipment and that soldiers are wearing it properly. Airborne training "initiates and sustains a high standard of proficiency through repetition and time proven techniques" (FM 3-21.220, 2003). Due to the extraordinary risk that paratroopers are exposed to, safety equipment and inspections are fundamental for successful airborne operations. The field manual identified in chapter nine that the "Primary Jump Master (PJM) is responsible for the inspection of the parachutists before an airborne operation" (2003), additionally "only a complete and systematic equipment inspection of each parachutist can the PJM ensure that personnel aboard the aircraft are safe to jump" (2003).

The PJM inspection uses an inspection process of control hand and working hand to trace and identify vital components of the parachute and equipment assembly. During the entire inspection process the eyes of the PJM follow the working hand, this process allows the PJM to "look at what is touched by the working hand" (FM 3-21.220, 2003). The process of tracing with the working hand described how the working hand moves along the item being inspected to

ensure that it is not cut, frayed, twisted, misrouted, or not present. During the tracing process the PJM also checks for sharp edges or items that can damage the parachute rigging, harness or parachute prior to, or during deployment.

The inspection process identifies 14 vital components of the parachutist's equipment that is necessary to minimize risk of injury or death to the combat parachutist. The US Army identified how the program has sustained it success over the years when it indicated that the results are valid when the program incorporated the following training standards; strict discipline, high standards of proficiency on each training practice, and a strong sense of esprit de corps. Finally, it addressed the emphasis on developing mental alertness, execution of commands, self-confidence and confidence in the equipment (FM 3-21.220, 2003). A second safety inspection is identified by the US Army where a parachutist and his/her partner rapidly inspect their parachute harness and equipment during the pre-jump sequence which is conducted during the jump preparation sequence five minutes prior to the parachutist leaving the aircraft.

The US Army identified many circumstances which a parachutist or equipment can become entangled or compromised during entry of the aircraft, during flight and maneuvering within the aircraft after the PJM inspection. The PJM during the jump sequence indicates to the parachutists with hand and arm signals immediately after the connection of the static line to the interior steel cable to "Check Equipment" (FM 3-21.220, 2003). During the equipment check the parachutist checks six components of the parachute equipment to ensure the rig is safe for airborne operations, during a matter of a few seconds the parachutist is able to ensure that the main parachute, reserve parachute, static line, equipment and other items will not interfere with the deployment of either the main or reserve parachute canopies. The US Army further identified when conducting rappelling operations for normal combat troops or special operations personnel

that a certain measure of safety, protective equipment and inspections were necessary to reduce the potential for soldiers to sustain life threatening injuries during these operations both in times of war and peace.

In the US Army Training Circular (TC) 21-24 the Rappel Master (RM) is “responsible for the safety of rappellers, all rope equipment and carabineers and personally supervises all rappelling operations”. Rappel operations as with all other training, must provide a safety briefing and inspection prior to rappel operations. During the pre-rappel inspection the RM performs a visual and physical inspection of the soldier and the equipment (TC 21-24, 1997). The RM inspects six main components that have been identified to interfere with the brake hand operations of rappelling or the rappel rope, prior to a soldier connecting to the rappel rope (TC 21-24, 1997).

The manual stated in chapter five, that failure to complete the inspection prior to rappel operations will result in the potential for equipment to be fowled which prevents proper decent control and can result in serious injury or death. In US Army guidance ATTP 3-118.12 *Air Assault Operations* the Rappel Safety Officer (RSO) is responsible for the overall safety of all rappellers and ensures that all safety equipment, briefings, inspections and precautions are followed. The US Army identified various ways in which soldiers can be inserted into combat or overcome obstacles resulting in the training and certification of soldiers as RM who master four common rappel applications to soldiers and special operations troops alike, and enacted physical safety inspections to reduce injuries and deaths. Another high-risk recreational activity enjoyed by millions of people around the globe each year is Self-Contained Underwater Breathing Apparatus (SCUBA) diving (PADI, 1994).

According to Professional Association of Diving Instructors (PADI), the largest provider and organizer of rules and regulations that pertain to SCUBA diving in the world indicated that SCUBA divers have a similar inspection process. The pre-dive safety check or "buddy check", to review the SCUBA gear prior to entering into the water, PADI identified the pre-dive safety check consists of checking five major components (PADI, 1994). The association identified this inspection is performed once a diver is wearing the diving equipment, as most diving accidents and incidents are identified as preventable by a diver conducting the pre-dive safety check (PADI, 1994). This safety check is required since numerous changes can be made to the diving equipment once the diver sets up the equipment and the time they enter the water, "a good intending crew member may close the air tank valve as to prevent the loss of air during travel to the dive site" (Gibb, nd).

The boat ride, and other bumps encountered may cause the gear to shift around and cause it to become disorganized or damaged. The process a diver performs to don the SCUBA gear may cause hoses to become entangled and create potentially life threatening conditions for a diver after entering the water. PADI identified "The pre-dive safety check is a last minute review to make sure that all of the gear is still functioning properly and arranged to a diver's satisfaction (1994). Nevin identified "The buddy pre-dive safety check is an important safety check that should be performed by every diver no matter what level of diving proficiency" (2009).

The author further stated "this check is performed by a diver with his/her buddy before descending on a dive as a final inspection of the dive equipment before diving" (Nevin, 2009). A diver may be 100% certain that the gear is perfectly assembled, but does the diver have the same level of confidence in their diving buddy's equipment. The pre-dive safety check ensures that

diving equipment is working, but also familiarizes the diver with the diving partners equipment should the need occur to assist one another while under water. “The pre-dive safety check in buddy teams familiarizes the divers with each other’s gear, helping them to assist each other efficiently in the unlikely event of an emergency” (PADI, 1994).

The *Open Water Diver* manual highlighted a good diving partner may also catch small mistakes in the equipment assembly that the partner overlooked as the pre-dive safety check forces a diver to stop, focus on the diving equipment and enter a proper mind set before entering the water. PADI recognized the diver is less likely to forget a step when there is a methodical system in use; this inspection can only take a matter of seconds for the diver to complete once the diver is comfortable using a methodical pre-dive safety check (1994). PADI created the mnemonic “Begin With Review And Friend” (1994) to help the diver remember the steps in order, while many dive instructors around the world have come up with other acronyms to assist the diver in remembering the steps to achieve the pre-dive safety check. The acronym highlighted five main inspection points that divers must ensure to increase diver safety prior to entering the water.

“Begin With Review And Friend” identified that partners and divers check the buoyancy compensator, weights, releases, air and final okay (PADI, 1994). PADI created the acronym “BWARF” to assist divers in remembering the steps taken to conduct the pre-dive safety check (1994). Nevin stated that “divers have come up with several different mnemonics to help them remember” the steps of the process (2009). Bush further identified the importance of visual inspections when he identified that “We are visual creatures. Nature intended us to navigate this world by sight” (Bush, 2012, p. 61).

In the realm of public safety underwater dive operations the author further identified how valuable a trained and competent tender or partner is vital to successful diving operations. Often used in public safety diving, the role of tender is seen as the official stay dry dive partner of the diver. The function of the tender is several roles in relation to the importance of the public safety diver, they include “director, assistant, and safety officer” (Hendrick & Zaferes, 2012, p. 75). “Well trained tenders help make sure divers are physically, mentally capable and their equipment is ready to dive” (Hendrick & Zaferes, 2012, p. 75).

The important work includes assembly and inspection of the equipment prior to the diver donning it, and both the tender and diver perform a full gear check prior to entering the operations area. The authors identified that a trained partner who is looking out for their teammate is essential to support, provide safety and protect the public safety diver (Hendrick & Zaferes, 2012, p. 72). SCUBA diving operations are gear-intensive, there are numerous pieces of equipment therefore, provides for potential problems; it is important divers have good quality gear and maintain it properly. One way to accomplish this is a thorough good pre-dive safety check where the diver can identify and eliminate potential problems (Hendrick & Zaferes, 2012, p. 71). This is accomplished with a tender or dive buddy so each member can check the other's gear at the same time.

A Mnemonic is a word utilized to describe a memory tool or technique for remembering information that is otherwise difficult to recall. The principle to the mnemonic is to encode difficult to remember information in a manner that is easier to recall. Congos (2006) identified that “mnemonics are memory devices that help learners recall larger pieces of information, especially in the form of lists like characteristics, steps, stages, parts, phases, etc”. There are nine

basic types of mnemonics that include “music, name, expression/word, model, ode/rhyme, note organization, image, connection and spelling” (Congos, 2006).

Scruggs and Mastropieri highlighted “Mnemonic instruction improves recall by systematically integrating specific retrieval routes within to-be-learned content” (1992). Mnemonics are techniques utilized by medical and non-medical professionals and students to improve memory by encoding information with a known association between new and previous information in the long-term memory (Berry, 2010). A mnemonic can be interjected or utilized during any phase of the education process when the individual takes “adequate time to learn and refine the skills necessary to make the use of the strategy worthwhile “(Berry, 2010). Teachers have used mnemonics to help students remember historical facts, musical lines, and spaces with even more teachers creating their own version of these tried and true memory tools.

Yin identified a “mnemonic is a device to help students remember words and facts. A mnemonic has many varieties that can help in memorization of many forms of information” (2012). During mnemonic instruction, students relate new information to what they have already learned through visual and verbal cues. The human brain is designed to code and interpret complex information such as images, colors, structures, sounds, smells, tastes, touch, positions, emotions and language which encompasses the world. Mastropieri and Scruggs identified that “mnemonics work best when they form a very clear link between known and unknown information” (1998).

The literature review indicated that there are several areas in which failure to ensure the proper wear of PPE can lead to injury and death of a firefighter. It also provided fundamental information on how leadership and program implementation can assist in creation of a program or process to assist firefighters performing spot equipment inspections to reduce injury or fatality

potential. Two high risk activities indicated spot equipment checks are necessary for the enjoyment and safety of the sport for participants. The United States Army has created spot inspections of equipment in both peace and combat operations to eliminate all means of unnecessary risks, injuries and deaths to increase the livelihood of the soldiers. These findings will assist MFD management in creating cultural change, creating policy and procedure that will reduce the potential of events leading to the death or injury of a MFD firefighter.

Procedures

This ARP used Action Research Method to identify and create a Rapid Sequence Spot Safety inspection process that allows firefighters or supervisory firefighters to rapidly validate that the rest of the team members have properly donned the PPE ensemble. This proposed process ensures that all closures are fastened, exposed skin is protected, and SCBA is operational to reduce the potential for a firefighter injury or death operating at the scene of a structure fire. The action method focused on creating a template and process to rapidly inspect the structural firefighting PPE ensemble, develop a lesson plan and Standard Operating Guideline (SOG) for MFD firefighters to complete a rapid sequence spot safety inspection prior to entering a burning structure, and to test the feasibility of the process, lesson plan and SOG.

The literature review for this project was initiated at the Learning Resource Center (LRC) on the campus of the National Fire Academy (NFA) at Emmitsburg, Maryland. This occurred while in attendance of Executive Fire Officer Program (EFOP) course Executive Leadership. The researcher initiated the search of the card catalog of the nation's largest collection of fire and emergency services related literature. Search terms included PPE, organizational culture, situational awareness, leadership, policy direction on how to implement successful safety

programs and actions, and NFPA codes and OSHA standards; the results produced journal articles, and web based content.

This review provided base material for further information gathering, methodology and previous detailed research to assist in the creation of the research questions and a guiding path for the research project. Additional research was conducted accessing the internet during numerous research periods utilizing different search engines such as Yahoo, Google, and Bing. Search terms included PPE, organizational culture, situational awareness, leadership, and policy direction. Furthermore, research was also conducted at the University of Wisconsin-Oshkosh Forrest R. Polk Library, Jim Dan Hill library at the University of Wisconsin-Superior, Union County Public Library, the student library located on the campus of Henderson Community College, the library of training materials and articles owned by the MFD and the researcher, and the library of training materials and field manuals of the 1st Battalion, 151st Infantry Regiment of the Indiana Army National Guard.

The gathered research material was compiled to determine which could potentially be utilized to identify code and standard requirements for inspecting PPE prior to engaging in high-risk activities, utilizing national fire standards, OSHA codes and other high-risk occupations and activities that require the use of PPE. The literature review and data collection also focused on organizational culture, situational awareness, leadership, and policy direction on how to implement successful safety programs and actions. NFPA codes and OSHA standards provided templates of items of the PPE to be inspected and checked prior to wearing, and standard operating guidelines and policies identified PPE checklists that detailed full inspections of the PPE ensemble that is completed after each use and during routine maintenance and cleaning.

These checklists failed to identify any rapid sequence or spot inspection that could be utilized prior to engaging in structural firefighting activities.

To understand the current situation in the MFD and the United States Fire Service with regard to firefighter injuries and deaths. Reports of various incidents along with other of statistical data on injuries and deaths of firefighters identified the common injuries and deaths of firefighters during fire ground activities in occupied structures. Voluntary participation questionnaires were distributed to the firefighters of the MFD, and firefighters of various departments with similar demographics in the State of Kentucky to gather information (Appendix A). Questionnaires were constructed using survey creation resources, and other information that pertained to data collection.

Surveys were distributed to all career and volunteer firefighters of the MFD, and selected similar departments within the state (Appendix B). The external questionnaire was submitted to fire departments that were of similar size, combination and population from the data contained in Kentucky Fire Chiefs Association department list (Appendix C). Each department was mailed a packet that contained the instructions on completing the survey instrument, surveys for firefighters, company and chief officers and return instructions. Some of the questions in the survey instrument required open-ended responses; as choices were not provided.

These questions were created to specifically identify which components of the PPE ensemble firefighters felt were necessary to be inspected to reduce the potential for injury or death, and to determine what employees or members identify as critical components of the PPE ensemble. The MFD employees and members were asked to complete the questionnaire using the provided forms during the allotted time during a training session. The out of town surveys included a time line of 30 days to complete and return to the researcher with self-addressed

stamped envelopes. Respondents were advised that the questionnaires were anonymous and no names or identifying statements were to be documented on the survey form.

All agencies and personnel were advised that participation in the survey was voluntary; however, participation was encouraged to assist in the creation of the rapid sequence spot inspection process and policy. Research from applicable codes, the survey instruments, standard operating practices and literature obtained from other high-risk activities such as SCUBA diving and parachuting or skydiving assisted in creating a template (Appendix D). To incorporate a rapid sequence spot inspection to identify major components of PPE utilized appropriately prior to engaging in the activity.

This template was utilized to create a process to conduct a rapid sequence spot safety inspection of required PPE firefighters wear during structural firefighting activities to reduce the potential for injury or death from inappropriate wear or lack of wearing the PPE ensemble. The rapid sequence spot safety inspection process was created and taught to Kentucky Certified Fire Instructors as the test group to establish time records and identify conditions which impair the inspection (Appendix I and J). The results of these trials identified the characteristics and points of inspection that members must rapidly identify within the allotted time frame. The process was documented into a training outline (Appendix D) and lesson plan (Appendix E).

The inspection process was trained and tested using two test groups. Group one was an internal test group that consisted of firefighters of the MFD, and group two was an external test group from the Sturgis Fire Department located in Union county. Both test groups were given the lesson and a block of instruction from the cadre of instructors on how to conduct the rapid sequence spot safety inspection, ten firefighters to rapidly evaluate and identify PPE violations,

and tested during two independent test cycles. Each group of ten firefighters contained three violations for their counterparts to rapidly identify.

Violations included: A firefighter whose hood was not up and the chin strap not fastened under the chin. Violation two, a firefighter had their protective coat tucked up and under the SCBA unit causing a gap in the protection of PPE ensemble, and the third violation was a firefighter who did not have the SCBA unit properly affixed to their torso and the waist strap not fastened. The firefighters with the violations during the test cycles were changed in placement between the two tests. The results of the rapid sequence spot safety inspection were utilized to indicate if changes to the process or procedure were necessary, to create a MFD Standard Operating Guideline (Appendix F), and establish a baseline average time it took to conduct the inspection to ensure rapid completion and not delay essential fire suppression operations.

Although the research process attempted to reduce limitations, there are areas of notable limitations during this project. The inquests of the questionnaires were not scientifically developed as a survey would be constructed, therefore may not provoke the desired response. Second, there is no control of the respondents which allows an opportunity for data to become construed due to similar responses from one person or many to accomplish the tools by the deadline. The external distribution method for the surveys was not scientifically developed and may skew the data.

There was very little available literature on the subject of spot PPE inspections, especially in both realms of fire service and industrial hygiene professions. The researcher observed the two test groups, but did not participate in the teaching, testing or documenting process. The noted violations for the testing and timing sequence were items that can easily be discovered, which may skew the validity of the testing cycles. Finally, the lead instructor for the regional training

area of the Kentucky Fire Rescue Training Commission selected the cadre of state instructors and adjacent fire department for testing purposes of external sources, their personal recommendation and bias may skew the results.

Results

The results of the research conducted for this ARP are provided in the format of the research questions and obtained from the literature review, formal interviews, survey results and action research. These results focused on creating and establishing a timed spot inspection of personal protective equipment, in which two test groups, internal and external experimented with the theory. A review of applicable OSHA and NFPA standards pertaining to PPE and firefighter safety produced many existing PPE inspection checklists that identified normal maintenance inspections are required by certain NFPA and OSHA codes to ensure that the PPE is clean, functional and operational. These checklists failed to identify any rapid sequence or spot inspection that could be utilized prior to engaging in structural firefighting activities.

An internal and external review of existing MFD and other fire departments operating guidelines and procedures that pertain to rapid sequence spot inspections failed to produce any policy or procedure on how to conduct this type of inspection. The survey instrument was created utilizing information obtained about spot inspections and attempting to identify a narrow field of equipment items to inspect. The full results of the survey questions are located in Appendix's G and H.

Research question one: What items of the PPE ensemble are identified by firefighters and fire officers as critical elements that must be visually checked prior to engaging in structural firefighting activities? Ninety percent of the questionnaire respondents identify the necessity to conduct a spot inspection of the PPE prior to engaging in structural firefighting activities.

Questions six, seven, eight, nine and ten all deal with the components of the firefighters PPE that should be included as part of the rapid sequence spot inspection. Many of the respondents indicated that all parts of the PPE ensemble are vital to the health and safety of firefighters.

Answers included “All items of PPE”, “Everything that prevents skin from exposure”, “Self-Contained Breathing Apparatus (SCBA)”, etc. Review of questionnaire responses to the question six of the survey, “Checking the firefighters head, neck, helmet, hood, SCBA and coat, describe what items to inspect and why?” provided many different responses. The highest responses of the internal questionnaire indicated respondents want to ensure there was no exposed skin, the area of the SCBA mask and hood interface, a few replied with all components. The results of the external questionnaire also indicated that firefighters felt the same as the MFD firefighters surveyed, although many additional respondents indicated the interface between the SCBA face piece and the protective hood is vital and should be included in the inspection process.

The importance of inspecting all items cannot be overlooked, however could prove to be time consuming when arriving firefighters are faced with potential life safety issues such as trapped victims. The emphasis on the SCBA and protective hood interface, the use of ear flaps and coat collars to provide a second layer of protection, along with the use of the helmet chin strap indicate focal points for firefighters to inspect.

Table 1: Question #6 (Internal Questionnaire)

Checking the firefighters head, neck, helmet, hood, SCBA and Coat, describe what items to inspect and why?		
Answer Provided	Percent response	Response Count
No exposed skin	43%	6
All components	36%	5
SCBA	21%	3
Question #6 (External Questionnaire)		
No exposed skin	32%	14

All components	14%	6
SCBA	68%	30
SCBA face piece hood interface	50%	22
Ear flaps and coat collar	32%	14
Helmet chin strap	14%	6

Question seven addressed inspecting the firefighters upper torso to include SCBA shoulder straps, and front torso of the protective coat, respondents felt “should straps should be tightened and stowed” so that no loose straps are exposed, the front closure of the coat is “fastened” and “not bunched up”, and gloves were on. Six respondents of the external questionnaire identified additional items they felt essential for the life and safety of the firefighter, identifying that the portable radio should be powered up and on the appropriate channel and the flashlight should be powered on.

Table 2: Question #7 (Internal Questionnaire)

Checking the SCBA shoulder straps and the front torso of the protective coat, describe what items to inspect and why?		
Answer Provided	Percent Response	Response Count
SCBA straps tight and flat	100%	14
Protective coat closed	100%	14
No exposed skin	64%	9
Question #7 (External Questionnaire)		
SCBA straps tight and flat	68%	30
Protective coat closed	15%	7
No exposed skin	32%	14
Radios on right channel	13%	6
Flashlights activated	13%	6

When addressing question eight, the need for the SCBA waist-strap to be fastened and inspected prior to participating in structural firefighting activities, 100% of the MFD firefighters indicated a need that this item be inspected. When compared to the external questionnaire, three respondents did not answer the question, while the remaining 41 respondents indicated that they

concur with the need to inspect and wear the waist-strap of the SCBA unit. The results of respondents when addressing the lower torso of the firefighter from the firefighters hips down, what items should be checked and inspected, respondents of the MFD identified that “coat should not be bunched up under the waist-strap of the SCBA”, “pants legs should not be pulled above the tops of the boots”, and that “suspenders should be properly worn” and not hanging out from the protective coat.

Table 3: Question #9 (Internal Questionnaire)

What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?		
Answer Options	Percent Response	Response Count
Coat bunched under waist strap	71%	10
Pants legs over boots	14%	2
Suspenders not hanging under coat	7%	1
No Answer		1
	Answered Question	14
	Skipped Question	0

Question #9 (External Questionnaire)

Answer Options	Percent Response	Response Count
Coat bunched under waist strap	59%	26
Pants legs over boots	26%	12
Suspenders not hanging under coat	15%	8
No Answer		7
	Answered Question	44
	Skipped Question	0

The results from the question addressing the inspection of the SCBA unit while looking at the firefighters back, respondents were asked to identify which components of the SCBA and PPE and why they felt it was important to check. Respondents to both the internal and external questionnaires provided similar answers to that of question nine. Answers included “air is on”,

"cylinder is full", properly worn protective coat that was "not bunched up" and that the suspenders were not hanging under the coat.

Table 4: Question #10 (Internal Questionnaire)		
What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?		
Answer Options	Percent Response	Response Count
SCBA unit on	100%	14
SCBA unit full	86%	12
Coat bunched under waist strap	28%	4
No Answer		0
	Answered Question	14
	Skipped Question	0

Question #10 (External Questionnaire)		
Answer Options	Percent Response	Response Count
SCBA unit on	45%	20
SCBA unit full	40%	18
Coat bunched under waist strap	27%	12
No Answer		5
	Answered Question	39
	Skipped Question	5

Research identified the majority of respondents felt PPE was vital to their safety and all components should be checked prior to engaging in firefighting activities. While many respondents listed two or three items to be checked for each given scenario in the questionnaire, many respondents felt exposure of skin, interface of components of the PPE ensemble and the SCBA unit was essential to firefighter survival.

Research question two: What are the rapid sequence spot inspections used by Self-Contained Underwater Breathing Apparatus (SCUBA) instructors and US Army Airborne units? A review of policies and procedures from SCUBA diving operations and US Army Airborne tactics both identify spot safety and equipment checks prior to engaging in high risk activities to

determine if they are applicable to create a process to spot check PPE for firefighting equipment. This review identified that a massive pre-activity inspection of lifesaving equipment is completed; a few points are inspected later, just prior to engaging in the high-risk activities. The spot inspections are conducted in a matter of seconds by a fellow diver or parachutist to ensure there have been no changes in the ability of the equipment to properly perform during the high risk activity.

PADI and the US Army identified specific points to be checked as part of a methodical safety check. Both organizations identified the need for detailed inspections in their process, but research was limited to a rapid sequence spot inspection to be conducted prior to engaging in the high risk activity. PADI identified five points are checked as part of the pre-dive safety inspection which is conducted by the diving partner of a SCUBA diver just prior to entering the water (1994). Those items include: buoyancy compensator, weights, releases, air and the final okay (PADI, 1994).

When addressing the issue of pre-dive safety checks Gibb identified a few rational principles on why a diver must check their gear again after donning it to partake in the sport.

> Between the time that a diver sets up his scuba equipment and the time that he rolls off the boat, a number of changes may be made to his gear. Helpful crew may close the tank valve so that air is not lost during travel to the dive site. A bumpy boat ride may shift gear around and damage or disorganize it. Even donning the scuba gear may cause some of the hoses to become entangled. The pre-dive safety check is a last-minute review to make sure that all of the gear is still functioning properly and arranged to the diver's satisfaction (Gibb, nd).

The author further highlighted that the pre-dive safety check is conducted with the diver's partner to familiarize both divers with each other's diving equipment (Gibb, nd). While Gibb specifically addressed the issue of getting a diver mentally prepared to enter the water, the pre-dive safety check was a great way to accomplish this. "The pre-dive safety check helps divers to stop, focus on their gear, and enter the diver mind set before jumping in the water" (Gibb, nd). Reinforcement for the belief of a proper pre-dive safety check, Seal stated "if you do a good pre-dive safety check you eliminate most potential problems. Do this with a buddy so each of you can check the other's gear at the same time" (Seal, nd).

PADI provided specific instructions on how to conduct the inspection of the five points of the pre-dive safety check. Step one: Check the Buoyancy Compensator (BC), check that the auto inflation button works, inflate the BC until fuller than needed before the diver enters the water. Next, check deflation mechanism. Let some air out until the BC is inflated enough that a diver will float when they enter the water.

Step 2: Check the Weight System, ensure the weight system is functional. If the diver is using a weight belt, make sure there are no twists and the weight is distributed evenly. It should be clear of all other gear. Ensure the buckle is positioned for a right hand release and the extended belt is not tangled or encumbered in any way. Different BC manufacturers have differing systems. Step 3: Check the BC device (BCD) and tank straps, check the BCD quick release buckles. Make sure they are actually snapped closed. Make sure the straps are snug. Ensure the tank band is snapped shut securely.

Step 4: Check Air and Regulator, at this point you should have opened your tank valve. Check that it's fully open and there are no leaks. Listen for air leaks at the tank valve. Test breathe the regulator, and watch the tank pressure gauge while it is done. If the pressure drops

quickly, the tank valve is either barely open or closed. Make sure the tank is full, and ensure the diving buddy knows where the location of the alternate air source. Step 5: Final Check, next, do a final once over. Make sure all other gear is on and unencumbered. Snorkels may be hung up in the BC and mask straps may be twisted. Once the final check is done, divers are ready to enter the water.

The US Army Airborne units also provide for the JM to provide a methodical equipment check as well as the paratrooper's partner provide a rapid spot check to verify that items that will limit or corrupt the ability of the parachute to open are checked prior to the paratrooper leaving the aircraft. The equipment check that is called for in the jump sequence identified that the static line, parachute package, reserve, and equipment rigging are inspected before identifying the final okay. In the Field Manual 3-21.220 *Static Line Parachuting Techniques and Tactics*, the US Army identified that these inspections should be conducted using a method of working hand and control hand to visually identify, physically inspect and check the equipment of a fellow parachutist's equipment. The US Army further referenced that the working hand process provides muscle memory for paratrooper's to ensure that equipment is checked in a methodical process.

Step one: Paratroopers must inspect the static line from the crown of the parachute, from the top of the parachute backpack assembly along the inboard/outboard arm of the paratrooper, up through the hand, and snapped onto the overhead steel line. Ensure there is no deviation, binding or distortion of the static line and ensure the locking clip is fastened. Step two: Inspect parachute package to ensure all deployment tabs are fastened with appropriate bands, if missing the jumper is not safe to parachute. Check the deployment handle and fastening links of reserve parachute to main parachute harness. Ensure metal wire is tabbed to deployment handle.

Step three: Check equipment rigging. Visually inspect hook and loop deployment straps at the top of the ALICE pack. Ensure rigging is fastened to main parachute harness, free of obstructions and the M1950 weapons case does not interfere with the drop line deployment of the ALICE pack. Ensure all equipment is tight against jumper's body and no loose equipment will interfere with jump door exiting.

Not every soldier is a paratrooper, but the US Army adopted the same working hand process during other high risk activities. The US Army identified in TC 21-24 *Rappelling Operations*, the importance of spot safety inspections for rappellers prior to stepping onto the rappelling platform. The RM will visually check and physically inspect the rappel seat the soldier tied to secure the locking carabineer to. This inspection also checks for proper knots, seat tightness, loose equipment or equipment that will foul rappel lines, excess rope stowage, and carabineer location.

Furthermore, the US Army identified a similar process of checking equipment prior to engaging in combat operations. This spot inspection ensures that not only is a ballistic helmet, and body armor properly wore, it further allows the senior non-commissioned officers to verify and ensure that all equipment necessary for the operation is accounted for and present. Such as individual weapons, radio and frequencies, ammunition, maps, etcetera.

Research question three: Can the inspection points provide a template for the MFD to create a procedure to conduct a rapid sequence spot safety inspection?

Sherrard identified that field inspections cannot cover everything all at once, "you can spot check at best" (2011, p. 47). The importance of spot checking PPE is to ensure it is inspected for "damage, proper fit and correct use" (Sherrard, 2011, p. 48), the fire service is not exempt from employees who may intentionally or accidently fail to properly wear the PPE

ensemble. The PPE ensemble is designed to protect the firefighter from the day-to-day risks, however, Dunn emphasized that “Today’s firefighters have good personal protection” (Dunn, 2012, p. 28). The author further stated that some firefighters overestimate the limitations of the PPE.

In the text *Fundamentals of Fire Fighter Skills* it specifically identified that prior to entering a burning structure “partners should check each other’s PPE to ensure it is on and working correctly before they enter the hazardous area” (2004, p. 27). During the review of checklists and other templates to conduct a rapid sequence spot safety inspection, many NFPA and OSHA codes provided detailed inspections that occur during after operations maintenance and cleaning procedures. The codes failed to pinpoint a specific spot inspection process to rapidly inspect PPE for proper wear and function. Utilizing the points identified in the research of high-risk activities safety inspections, PADI and the US Army have identified that partners check five or six points for a final inspection to ensure that necessary equipment is present and operating properly.

During the internal and external survey, respondents identified that helmets, coats, trousers, boots, gloves, hoods and SCBA should all be checked prior to entering an IDLH atmosphere. This assisted the researcher in compiling a template (Appendix D) of items that the survey respondents felt were necessary to be inspected prior to engaging in structural firefighting activities.

Research question four: Are there any existing acronyms or mnemonics being utilized that address firefighter rapid sequence spot safety inspections? The research found that there was no existing acronym or mnemonic that specifically addressed the rapid sequence spot safety inspection for firefighter PPE.

Research question five: What is the acceptable time to accomplish this rapid sequence spot safety inspection? To answer this question the research project conducted two timed test sessions, one with an internal test group of MFD firefighters and a second test group of Sturgis Fire Department firefighters. Each test group consisted of ten firefighters in the PPE ensemble with seven firefighters wearing their PPE appropriately, and three with violations of PPE wear that could result in the injury or death of the firefighter. Each test site evaluated each candidate in two separate test cycles.

The researcher identified that an inspection should be rapid as to not delay any fire suppression or rescue activities, and looked to having the inspection completed in ten seconds or less. In the internal test cycle, violations were assigned to positions three, six and eight in the first test cycle, and during the second test cycle, the positions were changed to positions five, seven, and nine. During the external test cycle, violations were assigned to positions two, four and eight, and during the second external test cycle, the positions were changed to positions three, six, and nine. The violations included: Violation one, a firefighter whose hood was not up and the chin strap not fastened under the chin.

Violation two is a firefighter, who had their protective coat tucked up and under the SCBA unit causing a gap in the protection of PPE ensemble, and the third violation was a firefighter who did not have the SCBA unit properly affixed to their torso and the waist strap was not fastened. The MFD firefighters during the test cycle had 15 participants who completed the first internal test time at an average of 7.74 seconds with an 88% accuracy rate in identifying the violations established for the test. Times and identification of violations improved on the second test cycle as the average inspection time improved to 7.24 seconds with a 94 % accuracy rate in identification of violations. This resulted in a net average time of completing the

inspection in 7.49 seconds with a 91% accuracy identifying situations of firefighters PPE that could result in a firefighter injury or death

During the external test cycles, Sturgis firefighters had 19 participants who completed the first test cycle in an average time of 6.93 seconds with a 92.8% accuracy rate discovering the violations of the PPE ensemble. As with the MFD firefighters, personnel from Sturgis had increased the time of inspection and accuracy rate during the second test cycle. The second test Sturgis firefighters completed the inspections at an average time of 6.5 seconds with a 97% accuracy rate. The Sturgis fire fighters averaged 6.72 seconds to conduct the inspection and had an overall accuracy rate of 95% in identifying violations in accordance with the inspection points of the rapid sequence spot safety inspections.

The results of the timed exercises to determine the baseline of the acceptable time to accomplish the rapid sequence spot safety inspection for the internal test is located in Appendix I and the external test is located in Appendix J.

Discussion

The 16 firefighter life safety initiatives are to change the culture of the fire service to make it safer. This ARP is looking to adopt a formal rapid sequence spot safety inspection of PPE prior to firefighters entering an IDLH atmosphere to conduct interior fire suppression operations. Fire suppression operations for the parameters of this ARP and the MFD include fire attack, ventilation, entry, rescue, overhaul, salvage and extinguishment. “OSHA along with business and industry leaders, have advocated safety programs for more than 30 years as a method not only of protecting oneself in the workplace” (USFA, 2008, p. 15).

While physical and personal health issues historically account for 50% of firefighter deaths annually, the remaining percentage deals with occupational safety issues (USFA, 2008, p.

15). Data from the United States Fire Administration identified that 87% of firefighter injuries reported to NFIRS were received while on the scene of a structure fire. Sixty-five percent of the reported injuries occurred in residential structures, the USFA identified that firefighting is by its very nature, a hazardous profession where injuries can and do occur (USFA, 2011, p.1). The internal and external survey instruments identified some alarming and astonishing trends.

Identified from survey results of question five, 59% percent of the respondents identified and stated that they felt receiving minor burns and injuries were acceptable injuries in the performance of their firefighting duties. More alarming were those respondents of question two, when asked if they have engaged in interior structural firefighting operations without all of the PPE being properly worn. Twenty-Five percent of the respondents indicated that they have entered a burning structure without wearing all items of the PPE ensemble. The respondents stated that at times they had forgotten to wear one or more items of the PPE ensemble due to "forgetting to pull up the hood", "forgetting to put on gloves" or "facilitating a rescue" of immediate victims.

Three respondents clearly indicated that they refuse to wear a protective hood, so that they may utilize their ear lobes for temperature indicators. This information indicates as much as 12% of the respondents indicated they have not worn all the issued PPE, do so willingly and place additional risks upon themselves and the firefighting team. Given the 10% of respondents who indicated that there is no reason to inspect PPE indicates that the information and research about firefighter injuries and deaths are not resonating with all fire service personnel, or they opt to ignore stated data and trends. The information identified about those who do not receive the information or opt to ignore it, should indicate a need for additional emphasis on firefighter safety and PPE use.

This information reiterates the point brought by Dunn, “today’s firefighters have good personal protection; however, some overestimate this personal protection and take great risks at fires with serious consequences” (2012, p. 28). The USFA identified “Very few of the firefighter injuries reported to NFIRS indicate problems with firefighter protective gear” (USFA, 2011, p. 8). NFIRS data indicated that 9% of the injuries were received by firefighters from a failure in the protective gear. During an interview with two MFD firefighters who received minor burns conducting search operations, they both stated “it is part of the job”.

Even though both firefighters did not lose work time, neither sought medical care of second degree burns, it was discovered that all PPE was properly worn and deployed that day. The cause of the firefighters’ injuries were a result in poor tactical decisions by mutual aid organizations who directed fire streams, heat, smoke and fire onto the two firefighters. Proper investigations into accidents and injuries provide insight into local emerging issues. Carter stressed fire officers are “the shepherd for their flock of followers” (2012), with the available information presented during the ARP, besides creating appropriate policy and procedure, a thorough investigation of each and every incident should be conducted.

Camplin advocated the need for “managers to review injury and accident data to identify potential problem areas” (2011, p. 35) when conducting the workplace hazard analysis. Fire service managers must change the culture within their organization where any injury or risk is acceptable, further managers must create policy and programs to ensure that firefighters properly wear all assigned PPE for the task at hand. Managers and supervisors cannot physically inspect every firefighter at all times while on an incident scene to ensure they are wearing the appropriate PPE. To facilitate an atmosphere where firefighters take care of each other, a safety conscious culture must be created by fire service managers.

Dunn stated that “Today’s firefighters have good personal protection” (2012, p. 28), Pillsworth identified the firefighter PPE ensemble “has limitations” (2009, p. 176). Both authors indicate that firefighters need to understand limitations of PPE and changing fire ground conditions which exceed the protective capabilities of the PPE ensemble. Dunn specifically identified that firefighters overestimate the limitations of PPE and take unnecessary risks at fire scenes resulting in serious consequences (2012, p. 28). To identify how to engage employees to correctly wear, maintain and know the limitations of the equipment, Sendelbach pointed “As leaders, it’s our job to counter resistance in order to achieve compliance” (2012, p. 12).

A cultural change must occur within the organization which identifies firefighters, officers and chiefs as a cohesive unit, must accept and challenge employees to embrace a safety conscious atmosphere. To mitigate these emerging issues, there is a need to identify the issues that lead to injuries and deaths, identify the best practices to prevent them from happening. To combat these emerging issues the topics of PPE use, safe emergency vehicle design and operations, use of a safety officer, determining and addressing local safety issues must be concentrated (USFA, 2008, p. 15).

The USFA stated that one combative measure is to “train personnel to be aware of the hazard and to follow safe job procedures to avoid it” (USFA, 2008, p. 15); including design and implementation of standard operating guidelines and standard operating procedures. PPE is designed to be a second level of protection when engineering controls cannot eliminate the hazard from the workplace. “PPE for firefighters is designed both to prevent injury or illness” (USFA, 2008, p. 16). The PPE of today is capable to provide full body protection and has been proven to save lives, with optimal proper care and maintenance.

Management and safety experts attributed six interventions are critical to safe operations, two of these six interventions address establishing, training, and enforcing safe operating procedures; as well as providing PPE as necessary (USFA, 2008, p. 22). "OSHA requires a manager to furnish a place of employment which is free from recognized hazards that are causing or likely to cause death or serious physical harm to employees" (Camplin, 2011, p. 42). OSHA general personal protective equipment requirement mandates "employers conduct a hazard assessment of the workplace, determine hazards present that require the use of PPE" (OSHA, 2003). Camplin further stated "use of PPE is the last option for controlling workplace hazards" (2011, p. 36), as managers must first use engineering and administrative controls to reduce or eliminate hazards.

OSHA mandated that employers protect their employees from workplace hazards that can cause injuries; this is accomplished by controlling and minimizing the hazard. "Depending upon the hazard or workplace conditions, OSHA recommends using engineering or workplace controls to manage or eliminate hazards" (OSHA, 2003). It further identified that "hazards exist in every workplace in many different forms" (OSHA, 2003). When engineering, work practice and administrative controls cannot effectively eliminate the hazard to the employees, OSHA requires the employer to provide appropriate hazard PPE to employees and ensure the use and care of the items.

The mandate stipulates that employers provide workers with appropriate PPE, train employees in its use, and require the employee to use and maintain the equipment in reliable condition. In the winter edition of *Job Safety & Health Quarterly* Walters stated "PPE is more convenient, comfortable, and effective than ever before. Properly used, it could save hundreds of

lives every year" (Walters, 2002, p. 34). PPE includes a variety of devices and garments to create a physical barrier from the hazard that moves throughout the jobsite with the employee.

"PPE has one major drawback: it's effectiveness depends upon people using it" (Walters,2002, p.34). PPE offers little or no protection when it is not properly maintained and inspected for wear, tear and serviceability. Even though PPE is an effective barrier, "health and safety professionals agree that the best way to protect workers is to rely on PPE only when other protections are not practical or available" (Walters, 2002, p. 34). Issuing an employee PPE is not enough, Walters identified that employees have to "wear it the right way, for as long as they are exposed to the hazard" (2002, p. 35).

Graveling stated "in many workplaces, PPE is used either as the only form of protection or as an additional line of protection to supplement other approaches" (Graveling, 2011, p. 18). Sherrard highlighted as part of a field inspection or safety check "PPE is physically inspected for damage, proper fit, and correct use" (2011, p. 48). Further on the subject of field inspections the author identified the necessity to train supervisors what to identify and how to inspect the items or types of PPE so that they can assist in the field inspection. "Inspections done on site in the field cannot possibly cover everything all at once. Pick one category to spot check" (Sherrard, 2011, p. 48).

The inspector can check for fit, sizing, condition, appropriateness of each item, and check each individual exactly the same way. Sherrard recommended the use of a checklist to ensure that the inspection process is thorough and completed the same way each time an inspection is conducted. The process of spot inspections allows managers and safety officials to periodically spot check policy compliance of employees (Sherrard, 2011, p. 47). During dynamic operations on the fire scene, a spot inspection should only take a matter of a few seconds as the

development and spread of fire does not allow a thorough detailed inspection of each item of the protective ensemble.

The discussion of changing the culture about the use and spot inspection of PPE requires fire service managers develop programs to change the behaviors of employees. In creating safety plans, goals and objectives should be established using the SMART method. This method is utilized in creating objectives and goals; of which those items are specific, measurable, attainable, realistic and timely. Hyden identified program management is accomplished by establishing standards, a measure of performance, and monitoring and control is necessary to ensure compliance and alignment with stated organizational goals (Hyden, 2012, p. 92).

Fire service managers must do by any means possible, what it can to reduce firefighter injuries and deaths. A strong commitment to reducing the number of injuries and fatalities is required from fire departments and its management teams for successful program creation and implementation. A thorough safety plan and commitment identified that "safety must be fully integrated into every activity, procedure and job descriptions" ((NFPA, 2004, p. 27). Standard operating procedures and guidelines are created to cover a variety of fire service functions, they "outline how to perform the various functions" (NFPA, 2004, p. 27).

A fire department safety program is only as effective as the individuals who implement it, enforce the policies and procedures, and the training program. These items are essential for firefighter safety, Best identified fire service supervisors must be aware of safety procedures as they "integrate safety plans and procedures into daily and emergency activity (2009, p. 37).

In *Fundamentals of Fire Fighter Skills*, the text identified that prior to engaging in interior offensive operations, firefighters must be properly equipped with approved PPE. "Partners should check each other's PPE to ensure it is on and working correctly before they

enter a hazardous area" (2004, p. 27). Additional fire service texts that are utilized during firefighter orientation and firefighter skills examinations further identified and reiterated proper use of PPE and comprehensive safety programs are driven to reduce firefighter injuries and deaths. Graham highlighted "proponents of PPE are the firefighters alive today because they took this control measure seriously" (2010).

Many high-risk sports and military activities conduct rapid sequence spot safety inspections of PPE, the fire service has very little literature on the subject of these inspections. Research did not identify any operating guidelines or procedures on conducting a PPE inspection that is spot or rapid sequence in nature. NFPA and OSHA codes both require formal inspections of PPE during weekly, monthly, bi-annual and after use operations of PPE maintenance and cleaning. The applicable codes failed to directly address a rapid inspection utilized prior to entering an Immediately Dangerous to Life and Health (IDLH) atmosphere associated with interior structural firefighting operations.

NFPA 1403 addressed the issue of spot PPE inspections prior to engaging in interior live fire operations, this inspection is conducted by safety officers and instructors prior to entering any acquired or fixed facility in which live fire operations will be conducted. When safety officers and instructors conduct this inspection they are checking to verify that all components of the PPE ensemble are properly wore and fastened. NFPA 1403 provided a detailed inspection format and an example of a checklist to ensure that the inspection is completed within the intention of the standard. Kentucky State Fire Rescue Training (SFRT), the training branch for the Kentucky Fire Commission also has a procedure that mirrors the inspection of PPE prior to live fire training evolutions addressed by NFPA 1403. In the SFRT policy, instructors check all

participants for proper wear of PPE prior to engaging in any training exercise such as structure fire training, flashover training, LPG gas fire emergencies, auto extrication, and many others.

This policy has been duplicated across many training topics to ensure safety of class participants and was driven by legal considerations and state established, mandated and provided workers compensation program for all volunteer firefighters in the commonwealth. NFPA 472 and OSHA standard CRF 1910.120 both specifically address inspection of and verification of the appropriate level of hazardous material PPE ensemble for all personnel prior to entering the warm or hot exclusion zones during a hazardous materials release or clean-up. Both codes provided the inspection format in detail with an annexed example of a checklist to ensure that the PPE inspection is completed in accordance with the intent of the standard.

The paratroopers of the United States Army deploy into combat via parachuting onto the battlefield. This high-risk activity identified numerous inspection processes to limit additional causalities to soldiers. Paratroopers are inspected a minimum of three times prior to departing the aircraft (FM 3-21.220, 2003). This research narrowed the parameters of spot inspections to a rapid process that is accomplished in a matter of a few seconds to ensure all equipment is still in its appropriate position and is still serviceable to jump.

During the boarding, traveling time, and preparation to parachute, there are numerous opportunities for a parachute, associated equipment or the paratrooper to become fouled (FM 3-21.220, 2003). Increased risk during this type of operation allows more opportunities a soldier will receive injuries or suffer an incident that results in the soldier becoming a fatality, affecting the combat effectiveness of the entire unit. Paratroopers perform a rapid sequence spot inspection of three steps with six points of inspection, of the parachute harness and equipment (FM 3-

21.220, 2003). This one final inspection is completed by a fellow paratrooper while the jumping unit has prepared for the upcoming operation.

During this inspection the paratrooper immediately behind the parachutist will inspect the parachute assembly, the paratrooper's equipment, and check that to ensure the static deployment line has not become fouled, tangled, or unattached while moving about the aircraft. This brief inspection is accomplished rapidly in a matter of three or four seconds. Each paratrooper in the jumping unit will conduct this inspection and verify completion by indicating "All Okay Jump Master" (FM 3-21.220, 2003). The US Army adapted similar inspection processes into other high risk activities such as rappelling operations, where the RM inspects several points of the rapeller's harness and carabineer connection before allowing a soldier to step to the side of a rappel site (TC 21-24, 1997).

The importance of a final safety check was recognized by PADI to be completed by SCUBA divers before entering the water. PADI identified five crucial points that are inspected by a diver and their diving partner as gear may have become tangled, fouled, accidentally changed, moved or turned off. The five inspection points that PADI identified are the buoyancy compensator, weight system, air system, releases, and final check. PADI identified there are many opportunities for a diver's equipment status to change from the time it is loaded on the vessel, and donned by the diver, until the time the diver is ready to utilize the equipment (1994).

The importance of conducting the pre-dive safety check with their diving partner helps both divers to familiarize each other with the diving equipment to assist with emergencies that may occur underwater. Hendrick and Zaferes identified the importance of the tender to assist the diver in the format of public safety diving (2012, p. 74). The tender is there to act as coach, team member and the diver's safety officer to the public safety diver.

The five points identified by PADI create the acronym BWARF, which reminds the diver to check the buoyancy compensator, weight system, air system, releases, final check (PADI, 1994). To assist divers with remembering the acronym, PADI gave the acronym a mnemonic of "Begin With And Review Friend" (PADI, 1994). Many divers have given it their own little flair by changing some of the words used, but staying with the BWARF acronym. Acronyms and mnemonics are utilized by educators to serve as a mental reminder for a person to remember a process, checklist or other vital information.

Congos (2006) identified that "mnemonics are memory devices that help learners recall larger pieces of information, especially in the form of lists like characteristics, steps, stages, parts, phases, etc". There are nine basic types of mnemonics that include "music, name, expression/word, model, ode/rhyme, note organization, image, connection and spelling" (Congos, 2006). Scruggs and Mastropieri stated "Mnemonic instruction improves recall by systematically integrating specific retrieval routes within to-be-learned content" (1992). Mnemonics are techniques utilized to improve memory by encoding information with a known association between new and previous information in the long-term memory.

A mnemonic can be interjected or utilized during any phase of the education process when the individual takes "adequate time to learn and refine the skills necessary to make the use of the strategy worthwhile "(Berry, 2010). Teachers have used mnemonics to help students remember historical facts, musical lines, and spaces, with even more teachers creating their own version of these tried and true memory tools. Yin identified that a "mnemonic is a device to help students remember words and facts. A mnemonic has many varieties that can help in memorization of many forms of information" (2012).

Utilizing mnemonic instruction, students can relate new information to what they have already learned. Mastropieri and Scruggs identified that “mnemonics work best when they form a very clear link between known and unknown information” (1998). Early education specialists use similar techniques known as educational songs, such as head, shoulders, knees and toes with pre-school children to identify body parts. The fire service utilizes acronyms and mnemonics to assist in teaching firefighters material. The acronym of PASS is utilized to identify the steps to take to use a fire extinguisher when teaching fire extinguishers to both fire service personnel and lay people.

The acronym of PASS identifies to Pull the pin, Aim the nozzle, Squeeze the lever and Sweep at the base of the fire. This is done to assist in remembering the steps for fire extinguisher use. While the mnemonic “Every good firefighter owns pretty red collar brass” aids firefighter in remembering the nine classifications of hazardous materials: explosives, gases, flammable liquids, flammable solids, oxidizers, poisons, radioactive materials, and other regulated materials. Acronym and mnemonic use is facilitated by education experts and personnel across the globe. Survey results identified that firefighters felt the major points of inspection include head, shoulders, legs and SCBA unit should be rapidly inspected to increase firefighter safety.

This created a template that identified a four point inspections process, with the close relation to the points of inspection the acronym of Head, Shoulders, Legs, SCBA (HSLSCBA) was reduced to Head, Shoulders, Knees, Air Flows (HSKAF). The mnemonic of “Hot Sauce Keeps All Fiery” was developed to reiterate the inspection points of the process. It was introduced in the process of this research project to amend the lyrics to the song head, shoulders, knees and toes to incorporate the points checked by firefighters performing a rapid sequence spot safety inspection. During the internal testing phase of the rapid sequence safety inspection, the

amended song lyrics to head, shoulders, knees and toes, changed to head, shoulders, knees and air flows was accepted very well by the firefighters of the internal and external test groups.

Firefighters in the test groups remember this from their own childhood, as well as sharing with their children, to identify certain body parts by signing and touching the body part. This concept was easily accepted by firefighters who were part of the test groups to identify the components of the PPE that is inspected. Upon exit interviews of the firefighters who tested the inspection process, the amended song was more accepted and recommended over the acronym that was provided. Firefighters also commented on the ease of the inspection, how a few "seconds" could make a difference in preventing injuries to other members of the firefighting team.

"We get complacent" with donning gear and this serves as a reminder that all components of the PPE ensemble are necessary to survive the fire ground. A few other firefighters felt the idea of a rapid sequence spot safety inspection was "a good idea", and that it was essentially designed for "looking out for our buddy".

Recommendations

The research and literature review for this research project revealed several areas for continued research and improvement. Some areas of research can benefit from immediate action to increase firefighter safety, while other areas will require further development or continual observation to determine cultural change towards the acceptance and implementation of a rapid sequence spot safety inspection. Research indicated that the MFD should incorporate the principles of the rapid sequence spot safety inspection into current fire suppression activities. To create a successful program, MFD must train all firefighters on the importance of rapid sequence spot safety inspections and the process of steps to complete the inspection.

Over the period of thirty days the department should train firefighters on the sequence of steps to conduct the inspection, perform numerous spot inspections of various compromises of the PPE ensemble to validate mastery of the skill and competency of individuals performing the inspections. During the procedural training period, chief officers of the MFD will implement the SOG dictating the performance of these inspections prior to engaging in any structural firefighting activity. After the initial implementation of the inspection program, the MFD must provide annual refresher training on the parameters of rapid sequence spot safety inspections outlined in MFD SOG 220.01 Rapid Sequence Spot Safety Inspection.

Annual refresher training will familiarize firefighters with the parameters, process and steps of a rapid sequence spot safety inspection, while enhancing the ability to rapidly spot and correct deficiencies in the PPE ensemble. The MFD should develop, acknowledge and embrace a safety culture to eliminate all roadblocks during safety guided decisions to provide for firefighter safety. The removal of such roadblocks and creation of a positive safety culture would lead to safer department operations.

The MFD should advocate for more research to be conducted on rapid sequence spot safety inspections of firefighter protective ensembles. This will assist in the ability to determine if any fire departments or other high-risk activities have established any similar procedures or policies of similar inspections. The MFD should participate with nationally recognized organizations and agencies to facilitate the adoption of a standardized inspection process to rapidly check the PPE ensemble prior to engaging in structural firefighting activities. National acceptance and advocacy for a standardized process will enable a more thorough, widespread field testing of the rapid sequence spot safety inspection.

Access to additional external test groups can conduct similar trials to verify and validate the time and standard of inspections beyond the limited capabilities of this research project. Upon completion of comprehensive testing verifying time and accuracy of this research, should be followed with a scientifically developed and scribed survey to determine if participants not only exhibited a change in behavior, but also embrace the concept of rapid sequence spot safety inspections. The research project created the acronym HSKAF to assist with remembering the points of the rapid sequence spot safety inspection, and some mnemonic play on an early education song assisted in cementing the procedure and steps of the inspection process. Further creation of a better acronym or mnemonic should be explored by different agencies which could increase the potential for other agencies to adopt this or similar inspection processes to increase firefighter safety and PPE use during structural firefighting activities.

Another item that should be investigated is a proposal to governing agencies in adopting mandatory rapid sequence spot inspections. This rapid sequence spot safety inspection is completed by members of firefighting teams prior to entering an IDLH atmosphere or any other hazardous atmosphere to engage in structural firefighting activities. As a result of implementing a national standard requiring such inspections, more data can be compiled to gauge the number of inspections, relate injury data and the presence or absence of such inspections. The fire service in general would benefit from further study of issues relating to firefighter PPE wear and spot inspections.

Areas of further study include continued review of incidents that result in injuries and deaths of firefighters, scientific surveys of firefighter attitudes and opinions regarding PPE use and spot inspections, rapid sequence PPE inspection studies or literature. These studies along with mandates at the state and national level could benefit all fire departments in the

Commonwealth of Kentucky and the United States by reducing risk and improving organizational safety applications.

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Appendix A

Chief Tim Whitham
Morganfield Fire Department
120 E. Main St.
Morganfield, KY 42437
(270)-389-2180

Dear Morganfield Firefighter,

Would you please take a few minutes of your time and complete a short survey to assist me in gathering data for an Applied Research Project that is investigating the creation and use of a spot personal protective equipment (PPE) inspection of the firefighter's PPE ensemble prior to entering a structure fire. The purpose of this research is to create an inspection process in which it is to identify and correct any problems with the firefighter's PPE to reduce the potential for a firefighter to suffer an injury or death. Thank you for taking this survey, it should only take a few minutes of your time. If you would like any information on the results obtained from this survey, please email me at twhitham@morganfieldfire.com.

Thank you,

Tim Whitham

The purpose of this research is to identify the major components of the PPE ensemble that should be inspected prior to entering into structural firefighting tactics. The purpose of the PPE as we all know is to reduce the potential for a firefighter to receive life-threatening injuries in an environment that we cannot control with other safety measures that can be engineered to eliminate all the hazards firefighters face. The results of this survey are completely anonymous and your results will not be disclosed to anyone. Please take a few moments to answer each question honestly.

1) Do you feel it is necessary to inspect your PPE and your partners PPE prior to entering into a burning structure? Yes/No
   Why?

2) For the purpose of this question, complete PPE includes the helmet, hood, protective coat and trousers, boots, gloves and SCBA. Have you ever entered into a burning structure to perform any offensive tactic without one or more of the PPE ensemble items either worn or properly worn? Yes/No
   Why?

3) Has the action taken in question 2 resulted in any injury whether it was reported to anyone or whether you received medical treatment including basic first aid after returning to the station or home? Yes/No

4) What were the injuries you sustained?

5) Do you feel that receiving minor burns even while wearing PPE is part of the job of a firefighter? Yes/No
   Why?

6) If you were to inspect a fellow firefighter prior to entering a burning structure and the only thing you could check, checking the firefighters head, neck, helmet, hood, SCBA and coat, please describe what items to inspect and why?

7) If you were to inspect a fellow firefighter prior to entering a burning structure and the only thing you could check, for this question checking the SCBA shoulder straps and the front torso of the protective coat. Please describe what items or components you would check and why?

8) Many firefighters operate on the fire scene without connecting the waist strap of the SCBA, if you are inspecting a firefighter prior to entering a burning structure, do you feel that the waist strap of the SCBA should be included in the inspection?
Yes/No

9) What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked and inspected checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?

10) When inspecting the SCBA unit while looking at the firefighters back please describe what items or components you would check and why?

Appendix B

Chief Tim Whitham
Morganfield Fire Department
120 E. Main St.
Morganfield, KY 42437
(270)-389-2180

Dear Fire Officer,

Would you please take a few minutes of your time and complete a short survey to assist me in gathering data for an Applied Research Project that is investigating the creation and use of a spot personal protective equipment (PPE) inspection of the firefighter's PPE ensemble prior to entering a structure fire. The purpose of this research is to create an inspection process in which it is to identify and correct any problems with the firefighter's PPE to reduce the potential for a firefighter to suffer an injury or death. Thank you for taking this survey, it should only take a few minutes of your time. If you would like any information on the results obtained from this survey, please email me at twhitham@morganfieldfire.com.

Thank you,

Tim Whitham

The purpose of this research is to identify the major components of the PPE ensemble that should be inspected prior to entering into structural firefighting tactics. The purpose of the PPE as we all know is to reduce the potential for a firefighter to receive life-threatening injuries in an environment that we cannot control with other safety measures that can be engineered to eliminate all the hazards firefighters face. The results of this survey are completely anonymous and your results will not be disclosed to anyone. Please take a few moments to answer each question honestly.

1) Do you feel it is necessary to inspect your PPE and your partners PPE prior to entering into a burning structure? Yes/No
   Why?

2) For the purpose of this question, complete PPE includes the helmet, hood, protective coat and trousers, boots, gloves and SCBA. Have you ever entered into a burning structure to perform any offensive tactic without one or more of the PPE ensemble items either worn or properly worn? Yes/No
   Why?

3) Has the action taken in question 2 resulted in any injury whether it was reported to anyone or whether you received medical treatment including basic first aid after returning to the station or home? Yes/No

4) What were the injuries you sustained?

5) Do you feel that receiving minor burns even while wearing PPE is part of the job of a firefighter? Yes/No
   Why?

6) If you were to inspect a fellow firefighter prior to entering a burning structure and the only thing you could check, checking the firefighters head, neck, helmet, hood, SCBA and coat, please describe what items to inspect and why?

7) If you were to inspect a fellow firefighter prior to entering a burning structure and the only thing you could check, for this question checking the SCBA shoulder straps and the front torso of the protective coat. Please describe what items or components you would check and why?

8) Many firefighters operate on the fire scene without connecting the waist strap of the SCBA, if you are inspecting a firefighter prior to entering a burning structure, do you feel that the waist strap of the SCBA should be included in the inspection?

Yes/No

9) What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked and inspected checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?

10) When inspecting the SCBA unit while looking at the firefighters back please describe what items or components you would check and why?

Appendix C

External Survey participation

Kentucky Fire Department Questionnaire Response Status				
Airport-Sorgho Responded	Central Hardin No Response	Clay Responded	Flaherty No Response	Hardinsburg No Response
Hebron No Response	Henderson Responded	Irvington No Response	Lake Dreamland No Response	Point Pleasant No Response
Poole Responded	Providence Responded	Radcliff No Response	Rineyville No Response	Russellville No Response
Sturgis Responded	Union County No Response	Wheatcroft Responded	Whispering Meadows No Response	

Appendix D

Template for PPE Inspection

Spot PPE Safety Inspection

Components to be checked prior to entry into an IDLH atmosphere

HEAD:

Helmet earflaps interface with protective coat collar
Protective hood, SCBA face piece and throat strap

Shoulders:

SCBA Shoulder straps and protective coat closure
Handheld radio, on and right channel
Flashlight on
SCBA cylinder remote gauge and PASS device

Torso:

SCBA waist strap, protective coat bottom, protective trousers
Gloves
Protective trouser legs and protective boots

SCBA Cylinder:

On, full operating

Appendix E

RAPID SEQUENCE SPOT PPE SAFETY INSPECTION

Lesson Topic:	How to conduct the rapid sequence spot personal protective equipment (PPE) safety inspection
Lesson Objective:	The students will conduct the rapid sequence spot PPE safety inspection to ensure that the firefighter PPE ensemble is worn properly and that team members inspect each other to ensure that critical components of the PPE ensemble are engaged and operating properly prior to entering an Immediately Dangerous to Life and Health (IDLH) atmosphere, particularly a structure that is involved with a free-burning state fire.
Level of Instruction:	Advanced
Length of Lesson:	30 Minutes
Student Motivation:	In order for fire fighters to safely engage in offensive and defensive firefighting tactics at the scene of a structure fire, firefighters must use PPE to protect them from the numerous hazards such as smoke, heat, toxins, hot water, etc. that firefighters are commonly exposed to during fire suppression operations. Firefighters must be able to rapidly inspect the PPE ensemble, spot deficiencies and ensure that team members are properly protected to minimize the potential for life threatening injuries or death. Fire fighters must be taught how to correctly wear and inspect their PPE.
Location of lesson:	Fire department training center
Equipment needed:	Appropriate visual aids Audio visual equipment Essentials of Fire Fighting, IFSTA, Fifth Edition Firefighter 1 & 2 Handbook, Fire Engineering, 2009 Edition Personal Protective Equipment

Presentation	Application
1. Importance of the Rapid Sequence Spot PPE Safety Inspection.	Firefighter injuries and deaths remain consistent every year, even though the numbers of structure fires have decreased over the last 30 years. 87% of all US firefighter injuries occur at the scene of structure fires. Firefighters follow PPE inspections prior to engaging in high risk activities as required by law through NFPA and OSHA standards. Rapid inspection of equipment is commonly used during other high risk activities such as SCUBA diving, and US Army Airborne operations, skydiving, etc.
2. PPE components to be checked prior to entry into an IDLH atmosphere in an attempt to reduce injuries and deaths to firefighters. HEAD: Helmet earflaps interface with protective coat collar. Protective hood, SCBA face piece and throat strap. SHOULDERS: SCBA Shoulder straps and protective coat closure. Handheld radio. Flashlight on. SCBA cylinder remote gauge and PASS device.	

TORSO: SCBA waist strap, protective coat bottom, protective trousers. Gloves. Protective trouser legs and protective boots. SCBA CYLINDER: On, full operating. 3. The inspection uses an inspection process of control hand and working hand to trace and identify vital components of the PPE and SCBA equipment assembly. With the left hand as the control hand and the right hand as the working hand the inspector during the entire inspection process the eyes of the inspector to follow the working hand, this process allows the inspector to look at what is touched by the working hand. The process of tracing with the working hand along the item being inspected to ensure that it is not cut, frayed, twisted, misrouted, or not present. 4. Inspection process: Demonstrate with outfitted firefighter to demonstrate the inspection process. HEAD:	Place the control hand on the right side of the firefighters head securing the chin strap, with the working hand, reach around the firefighters head and make contact with the control hand. Work the working hand around the back of the firefighters head, ensuring that the earflaps of the helmet interface with firefighters protective coat collar. Also ensure that the protective

	hood is resting on the shoulders underneath the protective coat collar. Verify that the neck strap of the SCBA face piece is lying flat on the back of the neck, and no portion of the collar is bound up in the shoulder straps or backpack assembly of the SCBA unit. Placing both the control and working hands on the firefighters SCBA face piece unsure that the protective hood is completely around and secure again the SCBA face piece and that no skin is exposed through any gaps or space. Ensure the chin strap is located under the chin and not interfering with the SCBA regulator or face piece and is secured. Ensure the throat strap of the protective coat is closed and that the protective hood is resting on the inside of the protective coat collar and no gaps between the coat collar, hood and face piece is evident.
SHOULDERS:	Taking the control hand place it on the firefighters right SCBA shoulder strap and the working hand on the firefighters left SCBA shoulder strap as far up on the shoulder as possible and run both hands as working hands down the length of the SCBA shoulder straps to ensure that they are tight, secured and lying flat on the torso of the

	firefighter not creating a bunching effect of the protective coat. Depending upon location on the SCBA straps check the PASS device and remote SCBA gauge to ensure that the air cylinder is full and the PASS device is armed. Take the right working hand and ensure the protective coat closure is secured and sealed by running down the length of the protective coat closure. Verify that the firefighter's radio is secured in its appropriate location.
TORSO:	Take the control and working hands reach around the firefighters torso as far around as possible, run both hands along the SCBA waist strap ensuring the strap is secured, tightened and lying flat with no rollover or bounding along the waist strap. Also ensure the SCBA unit has not pulled the protective coat up over the protective trousers creating an exposed gap in the protective ensemble. Ensure that the protective coat bottom is lying flat and overlaps the protective trousers waistband. Verify that the firefighter's gloves are on, and are not pushing up the sleeve of the protective coat; ensure the

	sleeve overlaps the wristlet of the protective glove. Look down and around the firefighter's legs to verify that the protective trouser legs are over the protective boots and not rising up anywhere on the firefighter.
SCBA CYLINDER:	Walk around the back of the firefighter and ensure the protective coat overlaps the protective trousers; the air cylinder is full, on and operating. Ensure the protective coat collar is up and interfaced with the helmet earflaps. Tap the firefighter on the left or right hip to indicate that the safety inspection is complete and the firefighter is ready to conduct fire suppression operations.
An easy way to remember all of this is to remember the acronym of **HSKAF,** or **HOT SAUCE KEEPS ALL FIREY** to assist the firefighters in memorizing the steps, sequence and items inspected to ensure the firefighter PPE ensemble is assembled properly and is "Combat Ready". One can also sing along with along with "HEAD, SHOULDER, KNEES and AIR FLOWS" while singing the song, you can touch the inspection points to aid in remembering the inspection points.	

LESSON RECAP:	The student will practice performing the operations in the job breakdown while under direct supervision.
EVALUATION:	The student will complete a manipulative performance test at a time determined by the instructor.
ASSIGNMENT:	Practice this job in order to prepare yourself for the upcoming performance test. Study for our next session.

Appendix F

MORGANFIELD FIRE DEPARTMENT Standard Operating Guideline		
Effective Date: **1 March 2013**	SOG Category & Identification Number: **Fire Operations – 200**	Revision: 0
SOG Title: **220.01 Rapid Sequence PPE Spot Safety Inspection**		
Approved by: Chief Tim Whitham	Re-evaluation Date: 30 November 2014	**Number of Pages:** 4

PURPOSE: To provide a specifically detailed and enforceable policy to dictate when and how firefighters of the Morganfield Fire Department conduct a Rapid Sequence PPE Inspection, this inspection is of the vital components of the personal protective ensemble that is necessary to reduce the potential for a life threatening injury or death. Conduct this inspection in a matter of a few seconds by members checking their teamed "buddy" prior to engaging in offensive tactical operations at the scene of a structure fire.

SCOPE: This procedure applies to all personnel of the Morganfield Fire Department; it is utilized for all applications to which any fire department responds.

In order to clarify terms in this procedure the following definitions have been included:

NONE:

SPECIAL NOTE: **THIS GUIDELINE WILL NOT OVERRIDE THE REQUIRED PPE INSPECTIONS ESTABLISHED BY NFPA AND OSHA FOR THE USE OF AND PRIOR TO ENGAGING IN SPECIALIZED RESCUE, HAZARDOUS MATERIALS OR LIVE FIRE TRAINING EXERCISES.**

GENERAL: These procedures will apply to all employees involved in any operations at a structure fire that involves the Morganfield Fire Department.

01.01. PPE INSPECTION PHILOSPHY.

A. The Morganfield Fire Department has created a PPE inspection policy from adapting rapid sequence spot inspections from high-risk activities such as SCUBA diving and parachuting.

B. The design of the inspection is for firefighters to inspect rapidly nine points of the PPE ensemble at four major body locations to verify that closures, components and SCBA is worn properly, sealed and activated. To attempt to reduce the potential for a firefighter to receive minor or life threatening injuries from gaps in the protective ensemble.

C. The department created the acronym of **HSKAF** to assist the firefighters in memorizing the steps, sequence and items inspected to ensure the firefighter PPE ensemble is assembled properly and is “Combat Ready”.

D. **HOT SAUCE KEEPS ALL FIREY** to remind firefighters of the points of inspection that can be sang along to head shoulders knees and toes.

01.02. INSPECTION POINTS.

A. Items to be inspected during the inspection process

B. Head
1) Helmet earflaps interface with protective coat collar
2) Protective hood, SCBA face piece and throat strap

C. Shoulders
1) SCBA Shoulder straps and protective coat closure
2) Handheld radio/flashlight
3) SCBA cylinder remote gauge and PASS device

D. Torso
1) SCBA waist strap, protective coat bottom, protective trousers
2) Gloves
3) Protective trouser legs and protective boots

E. SCBA Air Cylinder
1) Full, on, operating

01.03. INSPECTION PROCESS.

A. Regardless of initial entry or additional assignments, each member will conduct and receive the PPE inspection prior to entry into the involved structure.

B. Conduct each inspection process in the following manner to ensure firefighters identify and correct any deficiencies of all nine components prior to entry into a structure fire to reduce to the potential for minor or life-threatening injuries.

C. Head

1) Place the control hand on the right side of the firefighters head securing the chinstrap, with the working hand, reach around the firefighters head and make contact with the control hand.
2) Work the working hand around the back of the firefighters head, ensuring that the earflaps of the helmet interface with firefighters protective coat collar.
3) Ensure that the protective hood is resting on the shoulders underneath the protective coat collar.
4) Verify that the neck strap of the SCBA face piece is lying flat on the back of the neck, and no portion of the collar is bound up in the shoulder straps or backpack assembly of the SCBA unit.
5) Placing both the control and working hands on the firefighters SCBA face piece unsure that the protective hood is completely around and secure again the SCBA face piece and that there is no exposed skin through any gaps or space.
6) Utilize the chinstrap against the clasp, located under the chin and not interfering with the SCBA regulator or face piece.
7) Ensure the throat strap of the protective coat is closed and that the protective hood is resting on the inside of the protective coat collar and no gaps between the coat collar, hood and face piece is evident.

D. Shoulders

1) Taking the control hand place it on the firefighters right SCBA shoulder strap and the working hand on the firefighters left SCBA shoulder strap as far up on the shoulder as possible and run both hands as working hands down the length of the SCBA shoulder straps to ensure that they are tight, secured and lying flat on the torso of the firefighter not creating a bunching effect of the protective coat.
2) Depending upon location on the SCBA straps check the PASS device and remote SCBA gauge to ensure that the air cylinder is full and the PASS device is armed.
3) Take the right working hand and ensure the closure of protective coat closure by running the working hand down the length of the protective coat closure.
4) Verify that the firefighter’s radio is in its appropriate location.

E. Torso

1) Take the control and working hands reach around the firefighters torso as far around as possible, run both hands along the SCBA waist strap ensuring the strap is secured, tightened and lying flat with no rollover or bounding along the waist strap.
2) Ensure the SCBA unit has not pulled the protective coat up over the protective trousers creating an exposed gap in the protective ensemble. Ensure that the

protective coat bottom is lying flat and overlaps the protective trousers waistband.

3) Verify that the firefighter's gloves are on, and are not pushing up the sleeve of the protective coat; ensure the sleeve overlaps the wristlet of the protective glove.
4) Look down and around the firefighter's legs to verify that the protective trouser legs are over the protective boots and not rising up anywhere on the firefighter.

F. SCBA Air Cylinder

1) Walk around the back of the firefighter and ensure the protective coat overlaps the protective trousers; the air cylinder is full, on and operating.
2) Ensure the protective coat collar is up and interfaced with the helmet earflaps.
3) Tap the firefighter on the left or right hip to indicate that the safety inspection is complete and the firefighter is ready to conduct fire suppression operations.

01.04. AFTER INSPECTION OPERATIONS.

A. After the members complete inspection they are ready to engage in structural firefighting activities as directed by the Incident Commander.

B. Prior to each entry into the involved structure, team members will repeat the sequences above to ensure that the PPE ensemble is deployed and operational.

Appendix G

Internal Survey Results

Question #1		
Do you feel it is necessary to inspect your PPE and your partners PPE prior to entering into a burning structure? Why?		
Answer Options	Percent Response	Response Count
Yes	86%	12
No	14%	2
No Answer		0
	Answered Question	14
	Skipped Question	0
Important to ensure firefighter safety		5
Ensure it is worn properly		4
Safety first		1

Question #2		
For the purpose of this question, complete PPE includes the helmet, hood, protective coat and trousers, boots, gloves and SCBA. Have you ever entered into a burning structure to perform any offensive tactic without one or more of the PPE ensemble items either worn or properly worn? Why?		
Answer Options	Percent Response	Response Count
Yes	14%	2
No	86%	12
No Answer		0
	Answered Question	14
	Skipped Question	0
PPE is there for a reason		2
Did not get hood up		1
Unsafe if it is not worn properly		3

Question #3		
Has the action taken in question 2 resulted in any injury whether it was reported to anyone or whether you received medical treatment including basic first aid after returning to the station or home?		
Answer Options	Percent Response	Response Count
Yes		0
No	93%	13
No Answer		0
	Answered Question	13
	Skipped Question	1

Question #4		
What were the injuries you sustained?		
Answer Options	Percent Response	Response Count
No Answer	100%	12
	Answered Question	12
	Skipped Question	2

Question #5		
Do you feel that receiving minor burns even while wearing PPE is part of the job of a firefighter? Why?		
Answer Options	Percent Response	Response Count
Yes	36%	5
No	64%	9
No Answer		0
	Answered Question	
	Skipped Question	

Question #6		
Checking the firefighters head, neck, helmet, hood, SCBA and Coat, describe what items to inspect and why?		
Answer Options	Percent Response	Response Count
No exposed skin	43%	6
All components	36%	5
SCBA	21%	3
No Answer		0

Answered Question	
Skipped Question	

Question #7		
Checking the SCBA shoulder straps and the front torso of the protective coat, describe what items to inspect and why?		
Answer Options	Percent Response	Response Count
SCBA straps tight and flat	100%	14
Protective coat closed	100%	14
No exposed skin	64%	9
No Answer		0
	Answered Question	
	Skipped Question	

Question #8		
Many firefighters operate on the fire scene without connecting the waist strap of the SCBA, if you are inspecting a firefighter prior to entering a burning structure, do you feel that the waist strap of the SCBA should be included in the inspection?		
Answer Options	Percent Response	Response Count
Yes	100	14
No	0	0
No Answer		0
	Answered Question	
	Skipped Question	

Question #9		
What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?		
Answer Options	Percent Response	Response Count
Coat bunched under waist strap	71%	10
Pants legs over boots	14%	2
Suspenders not hanging under coat	7%	1
No Answer		1
	Answered Question	
	Skipped Question	

Question #10		
What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?		
Answer Options	Percent Response	Response Count
SCBA unit on	100%	14
SCBA unit full	86%	12
Coat bunched under waist strap	28%	4
No Answer		0
	Answered Question	
	Skipped Question	

Appendix H

External Survey Results

Question #1		
Do you feel it is necessary to inspect your PPE and your partners PPE prior to entering into a burning structure? Why?		
Answer Options	Percent Response	Response Count
Yes	93%	41
No	7%	3
No Answer		0
	Answered Question	44
	Skipped Question	0
Important to ensure firefighter safety		13
Ensure it is worn properly		20
Firefighters should not have to be inspected to ensure their gear is on correctly		1
Safety first		1

Question #2		
For the purpose of this question, complete PPE includes the helmet, hood, protective coat and trousers, boots, gloves and SCBA. Have you ever entered into a burning structure to perform any offensive tactic without one or more of the PPE ensemble items either worn or properly worn? Why?		
Answer Options	Percent Response	Response Count
Yes	11%	5
No	89%	39
No Answer		0
	Answered Question	44
	Skipped Question	0
Did not get hood up		1
Lost hood		1
Nothing showing on arrival		1
Forgot to don gloves		1
Use my ears as temperature probes		3

Question #3		
Has the action taken in question 2 resulted in any injury whether it was reported to anyone or whether you received medical treatment including basic first aid after returning to the station or home?		
Answer Options	Percent Response	Response Count
Yes	11%	5
No	89%	39
No Answer		0
	Answered Question	44
	Skipped Question	0

Question #4		
What were the injuries you sustained?		
Answer Options	Percent Response	Response Count
No Answer		32
	Answered Question	5
	Skipped Question	7
Burns to ears, neck		3
Minor burns to neck, face and ears		1
Minor burns to wrists and hands		1

Question #5		
Do you feel that receiving minor burns even while wearing PPE is part of the job of a firefighter? Why?		
Answer Options	Percent Response	Response Count
Yes	34%	15
No	59%	26
No Answer		3
	Answered Question	41
	Skipped Question	3
Dangerous occupation		15
Life rescue operations		18
Exposure to high heat and burning material		7
Wet clothing under PPE		3

Question #6		
Checking the firefighters head, neck, helmet, hood, SCBA and Coat, describe what items to inspect and why?		
Answer Provided	Percent Response	Response Count
No exposed skin	32%	14
All components	14%	6
SCBA	68%	30
SCBA face piece hood interface	50%	22
Ear flaps and coat collar	32%	14
Helmet chin strap	14%	6
No Answer		2
	Answered Question	42
	Skipped Question	2

Question #7		
Checking the SCBA shoulder straps and the front torso of the protective coat, describe what items to inspect and why?		
Answer Provided	Percent Response	Response Count
SCBA straps tight and flat	68%	30
Protective coat closed	15%	7
No exposed skin	32%	14
Radios on right channel	13%	6
Flashlights activated	13%	6
No Answer		0
	Answered Question	44
	Skipped Question	0

Question #8		
Many firefighters operate on the fire scene without connecting the waist strap of the SCBA, if you are inspecting a firefighter prior to entering a burning structure, do you feel that the waist strap of the SCBA should be included in the inspection?		
Answer Options	Percent Response	Response Count
Yes	86%	38
No	0	0
No Answer	11%	5

	Answered Question	41
	Skipped Question	3

Question #9		
What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?		
Answer Provided	Percent Response	Response Count
Coat bunched under waist strap	59%	26
Pants legs over boots	26%	12
Suspenders not hanging under coat	15%	8
No Answer		7
	Answered Question	37
	Skipped Question	7

Question #10		
What else in the area of the lower torso of the firefighter from the firefighters hips down should be checked prior to engaging in firefighting activities? Please describe what items or components you would check and why?		
Answer Provided	Percent Response	Response Count
SCBA unit on	45%	20
SCBA unit full	40%	18
Coat bunched under waist strap	27%	12
No Answer		5
	Answered Question	39
	Skipped Question	5

Appendix I

Internal Test Results Times

Internal Time Test Results

Test cycle 1 has violations located in tests positions 3, 6 and 8. Test cycle 2 has violations located at test positions 5, 7, and 9.

Candidate #1										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	8.14 sec	9.7 sec	5.22 sec	5.71 sec	6.53 sec	9.26 sec	6.79 sec	7.22 sec	6.39 sec	7.13 sec
Cycle 2	6.95 sec	8.21 sec	6.03 sec	5.98 sec	6.23 sec	8.78 sec	9.02 sec	7.56 sec	6.35 sec	7.1 sec
Violations Found			Yes		Yes		Yes		Yes	

Candidate #2										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	9.38 sec	7.25 sec	6.32 sec	7.82 sec	8.72 sec	8.64 sec	5.37 sec	6.4 sec	6.2 sec	6.23 sec
Cycle 2	8.98 sec	7.16 sec	6.45 sec	7.21 sec	8.22 sec	7.98 sec	5.69 sec	6.33 sec	6.5 sec	6.38 sec
Violations Found			Yes		Yes		Yes		Yes	

Candidate #3										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.4 sec	5.73 sec	6.47 sec	8.7 sec	10.66 sec	10.15 sec	8.14 sec	6.31 sec	6.98 sec	8.64 sec
Cycle 2	6.53 sec	5.98 sec	6.52 sec	6.99 sec	7.21 sec	8.02 sec	7.75 sec	7.32 sec	6.87 sec	6.92 sec
Violations Found			Yes		Yes		No		Yes	

Candidate #4										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.98 sec	6.02 sec	6.31 sec	6.69 sec	5.65 sec	5.24 sec	5.98 sec	6.23 sec	6.54 sec	6.12 sec
Cycle 2	6.55 sec	6.39 sec	5.96 sec	6.44 sec	5.97 sec	6.06 sec	5.11 sec	5.46 sec	5.57 sec	6.01 sec
Violations Found			Yes		Yes		Yes		Yes	

Candidate #5										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	7.12 sec	5.62 sec	5.95 sec	6.05 sec	6.11 sec	6.09 sec	5.92 sec	6.31 sec	5.34 sec	5.97 sec
Cycle 2	5.23 sec	5.6 sec	5.21 sec	5.25 sec	5.61 sec	5.08 sec	5.10 sec	5.45 sec	5.5 sec	5.72 sec
Violations Found			Yes		Yes		Yes		Yes	

Candidate #6										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	8.35 sec	8.82 sec	7.69 sec	7.22 sec	7.4 sec	7.92 sec	6.59 sec	6.34 sec	6.68 sec	6.12 sec
Cycle 2	7.96 sec	7.45 sec	7.66 sec	7.57 sec	7.21 sec	7.85 sec	7.5 sec	7.32 sec	7.52 sec	7.04 sec
Violations Found			Yes		Yes		Yes		Yes	

Candidate #7										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	18.14 sec	19.7 sec	22.52 sec	19.76 sec	19.38 sec	17.22 sec	17.82 sec	17.64 sec	18.70 sec	16.96 sec
Cycle 2	14.89 sec	16.96 sec	15.08 sec	16.21 sec	14.83 sec	15.89 sec	18.51 sec	16.32 sec	17.44 sec	17.02 sec
Violations Found			No		Yes		Yes		Yes	

Candidate #8										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.21 sec	6.85 sec	6.69 sec	6.32 sec	6.07 sec	6.14 sec	6.28 sec	6.56 sec	6.22 sec	6.47 sec
Cycle 2	6.38 sec	6.28 sec	6.66 sec	6.35 sec	6.67 sec	6.34 sec	6.68 sec	6.36 sec	6.1 sec	6.03 sec
Violations Found			Yes		No	Yes	Yes		Yes	

Candidate #9										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.85 sec	6.44 sec	6.29 sec	6.5 sec	6.08 sec	6.16 sec	6.32 sec	5.64 sec	5.82 sec	5.61 sec
Cycle 2	6.21 sec	6.17 sec	6.52 sec	5.98 sec	5.88 sec	5.76 sec	5.52 sec	5.14 sec	5.18 sec	5.36 sec
Violations Found			Yes		Yes	Yes	Yes		Yes	

Candidate #10										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.26 sec	6.34 sec	6.06 sec	6.62 sec	6.28 sec	6.56 sec	6.12 sec	6.24 sec	6.48 sec	5.96 sec
Cycle 2	6.29 sec	6 sec	6.03 sec	5.87 sec	5.19 sec	5.38 sec	5.76 sec	5.52 sec	5.04 sec	5.08 sec
Violations Found			Yes		Yes	Yes	Yes		Yes	

Candidate #11										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.96 sec	5.61 sec	5.57 sec	5.14 sec	5.28 sec	5.56 sec	5.12 sec	5.24 sec	5.48 sec	5.96 sec
Cycle 2	5.29 sec	5.87 sec	5.19 sec	5.25 sec	5.84 sec	5.06 sec	5.02 sec	5.69 sec	5.31 sec	5.49 sec
Violations Found			Yes		Yes	Yes	Yes		Yes	

Candidate #12										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	14.83 sec	12.45 sec	13.28 sec	14.56 sec	15.12 sec	14.24 sec	14.48 sec	16.32 sec	17.20 sec	12.48 sec
Cycle 2	13.57 sec	15.03 sec	17.64 sec	16.24 sec	12.48 sec	11.96 sec	11.92 sec	10.84 sec	10.68 sec	10.36 sec
Violations Found			Yes		Yes	No	Yes	No	Yes	

Candidate #13										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.4 sec	6.36 sec	6.76 sec	6.52 sec	6.04 sec	6.08 sec	6.16 sec	5.32 sec	5.64 sec	5.28 sec
Cycle 2	6.05 sec	6.01 sec	6.06 sec	5.12 sec	5.24 sec	5.84 sec	5.32 sec	5.96 sec	5.44 sec	5.04 sec
Violations Found			Yes		Yes	Yes	Yes	No	Yes	

Candidate #14										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.62 sec	5.13 sec	5.57 sec	5.32 sec	5.16 sec	5.67 sec	5.46 sec	5.79 sec	5.71 sec	5.42 sec
Cycle 2	5.48 sec	5.02 sec	5.5 sec	5.16 sec	5.51 sec	5.66 sec	5.23 sec	5.6 sec	5.16 sec	5.82 sec
Violations Found			Yes		Yes	Yes	Yes	Yes	Yes	

Candidate #15										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.48 sec	5.41 sec	5.14 sec	5.03 sec	5.16 sec	5.22 sec	5.41 sec	5.85 sec	5.7 sec	5.44 sec
Cycle 2	5.37 sec	5.29 sec	5.66 sec	5.53 sec	5.85 sec	5.67 sec	5.37 sec	5.04 sec	5.08 sec	5.68 sec
Violations Found			Yes		Yes	Yes	Yes	Yes	Yes	

Appendix J

External Test Results Times

External Time Test Results

Test cycle 1 has violations located in test positions 2, 4, and 8. Test cycle 2 has violations located at test positions 3, 6, and 9.

Candidate #1										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.17 sec	6.38 sec	6.29 sec	6.38 sec	6.14 sec	6.36 sec	6.72 sec	6.44 sec	6.08 Sec	6.23 sec
Cycle 2	6.31 sec	6.11 sec	7.09 sec	6.26 sec	6.2 sec	6.42 sec	6.22 sec	6.05 sec	6.89 sec	6.36 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #2										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	8.24 sec	8.72 sec	8.22 sec	8.71 sec	8.53 sec	8.26 sec	8.79 sec	8.22 sec	8.39 sec	8.13 sec
Cycle 2	7.95 sec	7.91 sec	8.03 sec	7.89 sec	7.62 sec	7.71 sec	8.02 sec	7.56 sec	7.53 sec	7.98 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #3										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	7.23 sec	7.09 sec	7.81 sec	7.01 sec	7.22 sec	7.31 sec	7.04 sec	7.95 sec	7.5 sec	7.77 sec
Cycle 2	7.61 sec	7.22 sec	7.39 sec	7.54 sec	7.36 sec	7.89 sec	7.01 sec	7 sec	6.98 sec	7.51 sec
Violations Found		Yes	Yes	Yes		Yes		No	Yes	

Candidate #4										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	7.95 sec	7.35 sec	7.3 sec	7.06 sec	7.66 sec	7.32 sec	7.46 sec	7.21 sec	7.38 sec	6.69 sec
Cycle 2	6.95 sec	6.29 sec	6.26 sec	6.24 sec	6.94 sec	6.42 sec	6.28 sec	6.91 sec	6.03 sec	6.26 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #5										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	13.57 sec	12.84 sec	12.45 sec	10.15 sec	17.64 sec	10.97 sec	10.62 sec	10.24 sec	11.48 sec	10.96 sec
Cycle 2	12.48 sec	11.97 sec	11.45 sec	12.35 sec	10.78 sec	10.03 sec	10.06 sec	9.12 sec	9.28 sec	9.63 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #6										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.15 sec	5.39 sec	5.54 sec	5.08 sec	5.11 sec	5.27 sec	5.45 sec	5.99 sec	5.42 sec	5.84 sec
Cycle 2	5.42 sec	5.5 sec	5.19 sec	5.16 sec	5.27 sec	5.54 sec	5.08 sec	5.61 sec	5.77 sec	5.54 sec
Violations Found		Yes	Yes	No		Yes		No	No	

Candidate #7										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.31 sec	6.36 sec	6.76 sec	6.52 sec	6.4 sec	6.16 sec	6.01 sec	6.06 sec	6.05 sec	5.96 sec
Cycle 2	6.32 sec	6.46 sec	6.22 sec	5.96 sec	5.84 sec	5.44 sec	5.21 sec	5.33 sec	5.12 sec	5.04 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #8										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.4 sec	6.36 sec	6.76 sec	6.52 sec	6.04 sec	6.08 sec	6.16 sec	5.32 sec	5.64 sec	5.28 sec
Cycle 2	6.05 sec	6.01 sec	6.06 sec	5.12 sec	5.27 sec	5.74 sec	5.32 sec	5.91 sec	5.24 sec	5.04 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #9										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.49 sec	6.73 sec	6.47 sec	6.87 sec	6.26 sec	7.04 sec	8.14 sec	6.31 sec	6.98 sec	8.64 sec
Cycle 2	6.43 sec	6.59 sec	6.52 sec	6.89 sec	6.21 sec	8.02 sec	7.75 sec	6.32 sec	6.37 sec	6.12 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #10										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	10.48 sec	11.24 sec	11.28 sec	10.66 sec	10.22 sec	10.28 sec	10.82 sec	16.03 sec	11.21 sec	10.68 sec
Cycle 2	9.53 sec	9.01 sec	9.76 sec	9.34 sec	9.81 sec	9.38 sec	9.84 sec	9.08 sec	9.86 sec	9.03 sec
Violations Found		No	Yes	Yes		Yes		Yes	Yes	

Candidate #11										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.69 sec	5.63 sec	5.97 sec	5.41 sec	5.82 sec	5.65 sec	5.02 sec	5.43 sec	5.84 sec	5.91 sec
Cycle 2	5.32 sec	5.29 sec	5.7 sec	5.52 sec	5.17 sec	5.19 sec	5.62 sec	5.46 sec	5.67 sec	5.36 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #12										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.64 sec	6.63 sec	6.17 sec	6.25 sec	6.34 sec	6.02 sec	6.05 sec	5.91 sec	5.16 sec	5.23 sec
Cycle 2	6.04 sec	6.01 sec	6.12 sec	6.14 sec	5.31 sec	5.62 sec	5.24 sec	5.48 sec	5.69 sec	5.56 sec
Violations Found		Yes	Yes	Yes				Yes	Yes	

Candidate #13										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.72 sec	5.15 sec	5.87 sec	5.74 sec	5.42 sec	5.9 sec	5.08 sec	5.48 sec	5.36 sec	5.72 sec
Cycle 2	5.5 sec	5.32 sec	5.82 sec	5.64 sec	5.38 sec	5.47 sec	5.28 sec	5.19 sec	5.38 sec	5.78 sec
Violations Found		Yes	Yes	Yes				Yes	Yes	

Candidate #14										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.97 sec	5.68 sec	5.41 sec	5.63 sec	5.61 sec	5.72 sec	5.81 sec	5.65 sec	5.6 sec	5.69 sec
Cycle 2	5.68 sec	5.85 sec	5.67 sec	5.53 sec	5.37 sec	5.67 sec	5.16 sec	5.28 sec	5.19 sec	5.2 sec
Violations Found		Yes	Yes	Yes				Yes	Yes	

Candidate #15										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.83 sec	6.64 sec	6.6 sec	6.53 sec	6.61 sec	6.04 sec	6.14 sec	6.63 sec	6.11 sec	6.09 sec
Cycle 2	6.64 sec	6.33 sec	6.16 sec	6.42 sec	6.08 sec	6.19 sec	6.06 sec	5.92 sec	5.96 sec	5.82 sec
Violations Found		Yes	Yes	Yes				No	No	

Candidate #16										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.35 sec	5.69 sec	5.64 sec	5.8 sec	5.31 sec	5.72 sec	5.54 sec	5.6 sec	5.41 sec	5.04 sec
Cycle 2	5.26 sec	5.35 sec	5.92 sec	5.56 sec	5.23 sec	5.54 sec	5.07 sec	5.67 sec	5.69 sec	5.44 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #17										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	5.81 Sec	5.24 Sec	5.96 sec	5.54 sec	5.72 sec	5.19 sec	5.06 sec	5.93 sec	5.45 sec	5.51 sec
Cycle 2	5.24 sec	5.51 sec	5.91 sec	5.61 sec	5.55 sec	5.95 sec	5.88 sec	5.23 sec	5.85 sec	5.26 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	

Candidate #18										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	6.62 sec	6.43 sec	6.01 sec	6.13 sec	6.04 sec	5.95 sec	6.02 sec	5.94 sec	5.91 sec	5.98 sec
Cycle 2	6.09 sec	6.01 sec	6.03 sec	5.98 sec	5.92 sec	5.83 sec	5.68 sec	5.64 sec	5.16 sec	5.09 sec
Violations Found		No	Yes	Yes		Yes		Yes	Yes	

Candidate #19										
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Cycle 1	7.69 sec	7.54 sec	7.46 sec	7.52 sec	7.42 sec	7.58 sec	7.6 sec	7.32 sec	7.29 sec	7.24 sec
Cycle 2	7.98 sec	7.87 sec	7.82 sec	7.91 sec	7.84 sec	7.76 sec	7.52 sec	7.44 sec	7.38 sec	7.36 sec
Violations Found		Yes	Yes	Yes		Yes		Yes	Yes	