

ALTERNATIVE PPE

THE LATEST FIRE REVOLUTION



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INTRODUCTION

Given the difficult nature of firefighting, firefighters are at risk of developing heat stress more often than the public. It currently tops the charts as the leading cause of firefighter occupational deaths and contributes to health conditions including heatstroke, cardiac fatigue, and cardiovascular failure. It's important to reduce overexertion and over-heating as often as possible.

The following pages contain articles and case studies that support the use of alternative PPE as a means of heat stress reduction in cases where NFPA 1971 structural PPE is not necessary.

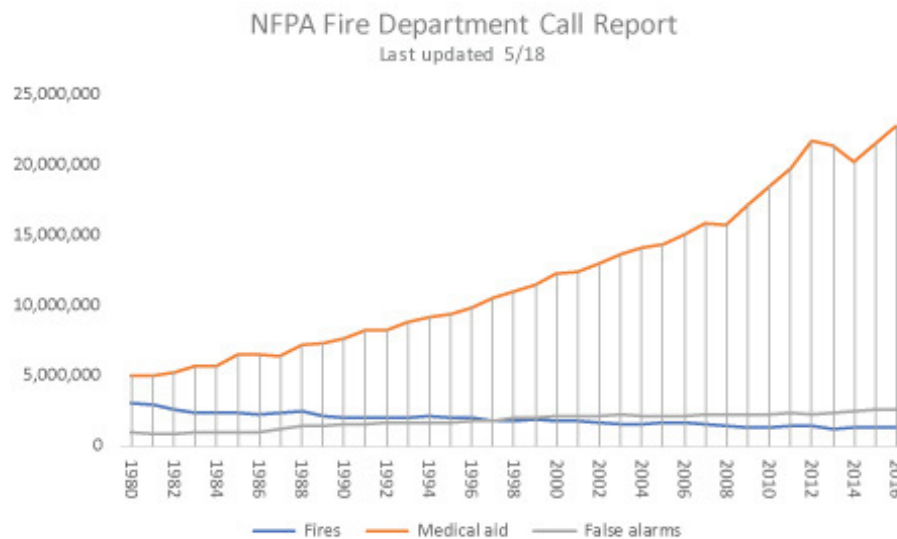
RESOURCE:

1. Firefighter Fatalities in the United States, Rita F. Fahy, Jay T. Petrillo, and Joseph L. Molis, NFPA, July 2020 and previous reports in the series Updated 7/20
<https://www.nfpa.org/News-and-Research/Data-research-and-tools/Emergency-Responders/Firefighter-fatalities-in-the-United-States/Firefighter-deaths-by-cause-and-nature-of-injury>

HOW CALL VOLUME IS CHANGING THE FIRE SERVICE

To understand the impact that wearing alternative PPE can have on your health over time, you must first recognize how often you're wearing structural gear when an alternative garment is more suitable. When dispatch calls, there's a vast number of scenarios that can follow. You might deploy to a fire scene, but most likely, you're sent to an MVA, medical emergency, or possibly a hospital transport.

Even as overall call volume has risen over the years, the [National Fire Protection Association](#) (NFPA) reports fire calls have dropped by a whopping 23.8% between 1980-2016 - that's almost 1/4 of the fires! On the other hand, EMS calls have spiked up 17.8%.⁽¹⁾



So, what has changed in our industry, in our communities, and across our nation to make such a drastic impact on the services provided by fire departments today?

THE BEGINNING OF FIRE PREVENTION TRAINING

[America Burning](#) (a 1973 research report published by the National Commission of Fire Prevention and Control) is credited for being the leader in educating the public on methods of fire prevention. As a result of this report, the U.S. Congress, with support from President Gerald Ford, approved the Federal Fire Prevention and Control Act of 1974.⁽²⁾ This led to several initiatives which aimed to reduce fires by strengthening firefighter training, spreading prevention awareness, and implementing stricter safety protocols. Initiatives included:

- The National Fire Prevention and Control Administration, simply known today as the U.S. Fire Administration (USFA),
- the National Fire Academy for Fire Prevention and Control,
- the National Fire Incident Reporting System, and
- the Center for Fire Research.

CONFIDENCE IN EMERGENCY SERVICES LEADS TO RISE IN 911 CALLS

The public has become increasingly mindful of the availability and accessibility of 911 EMS support. Since its inception in 1957, the National Association of Fire Chiefs' simple number for reporting fires has taken on a whole new meaning. 911 is now known as the national telephone number that offers citizens free, fast, and easy access to safety services.

Thanks to the President's Commission on Law Enforcement and Administration of Justice, the phone line allows access to national reporting for all emergencies- not just fires. This resource, coupled with public recognition of different signs of common medical ailments, has increased the likelihood of citizens calling for help. For example, left-sided weakness could be a symptom of a stroke, and SOB followed by back pain could be a precursor to a heart attack. Though contrary to this evolution, only 17% of fire departments provide advanced life support (ALS), 46% offer basic life support (BLS), and nearly 38% don't offer any form of emergency medicine, according to the [U.S. Fire Department Profile Survey](#) collected over 2017-2019. ⁽³⁾

STRUCTURAL FIRES HAVE CHANGED

In response to a broader understanding of fire safety and prevention, fire codes have become stricter over the years. The [NFPA 101 Life Safety Code](#) ⁽⁴⁾ has undergone multiple updates by adding requirements for escape routes and alarms/detection systems to fire sprinklers and protection for interior finishings. Overall, our society has advanced from the days of covering wood furnishings with vinegar, alum, and clay as methods of fire-proofing. Today, flame retardant chemicals are applied to fabrics and materials to slow or prevent the ignition or growth of a fire. These chemicals can be found inside modern upholstery, carpets, electronics, and seat covers.

Although, we are not necessarily safer from fires in today's world. Despite the reduction in fires, homes are built with cheaper materials, and furnishings are coated with more chemicals, so modern homes that don't catch fire burn much hotter and faster than they once did. UL's "[Comparison of Room Furnishings](#)" video published on October 13, 2016, shows a side-by-side comparison showing how dangerous house fires are.

According to the National Fire Protection Association, residents have a mere 2 minutes to get out of a modern home and reach safety. Thanks to the increased public awareness of preventative measures, such as running routine fire inspections, fire drills, and using fire alarms, these are now standard practices.

OTHER FACTORS AFFECTING CALL VOLUME

Some other factors contributing to the large swing in call volume include:

- Development of fire-proof materials
- Population growth
- Longer life expectancy

RESOURCES:

1. NFPA, Fire Department Calls 1980-2020 NFPA Fire Experience Survey Updated 11/21 <https://www.nfpa.org/News-and-Research/Data-research-and-tools/Emergency-Responders/Fire-department-calls>
2. Burning America, The Report of The National Commission on Fire Prevention and Control
3. NFPA's "U.S. Fire Department Profile" by Ben Everts and Gary P. Stein March 2021, <https://www.nfpa.org/News-and-Research/Data-research-and-tools/Emergency-Responders/US-fire-department-profile>
4. NFPA 101 Life Safety Code Handbook, Paul E. Teague, M.A. and Updated by Chief Ronald R. Farr https://www.nfpa.org/~media/Files/forms%20and%20premiums/101%20handbook/NFP101HB09_CHS1.pdf

HOW WEARING ALTERNATIVE PPE CAN PROTECT YOU

Research from the [American Heart Association](#) shows that exposure to extreme heat and physical exertion during firefighting may trigger the formation of blood clots and impair blood vessel function, the two predecessors of heart attacks. Blood clotting is an exaggerated physiological response to extreme heat and physical exertion.

As a firefighter, you understand that staying hydrated and allowing time to cool your body is crucial, but did you know choosing the right gear for the call can also help?

Wearing structural gear during non-fire emergencies can cause unnecessary stress on your body while contributing to repeated exposure to contaminants. Wearing single-layer, lightweight gear, like TECGEN51 Fatigues offers a perfect alternative. These fatigues provide high levels of thermal protection, are dual-certified, and are breathable.

When responding to non-structural calls including motor vehicle accidents, extrication, rescue, or incident command, you can rely on TECGEN51 Fatigues. Choosing to wear this alternative PPE will protect your valuable turnout gear from contamination and UV exposure while improving its longevity. In the following pages you will find articles that argue the need to reduce the use of structural PPE alongside supportive evidence of how it can positively impact your health.

RESOURCES:

1. Firefighter Fatalities in the United States, Rita F. Fahy, Jay T. Petrillo, and Joseph L. Molis, NFPA, July 2020 and previous reports in the series Updated 7/20; <https://www.nfpa.org/News-and-Research/Data-research-and-tools/Emergency-Responders/Firefighter-fatalities-in-the-United-States/Firefighter-deaths-by-cause-and-nature-of-injury>
2. American Heart Association Rapid Access Journal Report April 3, 2017 <https://newsroom.heart.org/news/extreme-heat-exposure-linked-to-firefighter-heart-attacks>

It's Time to Limit Wearing of Firefighting Turnout Gear

Posted by: [Robert Avsec, Executive Fire Officer](#) February 5, 2019 [0 Comments](#)

By: **Robert Avsec, Executive Fire Officer**

Can we please stop wearing our structural firefighting PPE for anything other than structural firefighting or training for structural firefighting?



Photo Source: Source: 21 Insightful Quotes About Embracing Change, <https://www.success.com/21-insightful-quotes-about-embracing-change/>

The science is telling us that our structural firefighting ensemble (PPE) absorbs the toxic chemicals, chemical compounds, and carcinogens present in the smoke of today's structure fires. While gross decontamination may remove a large amount of visible soot and other debris after a firefighter exits the hazard area, it does nothing for removing those contaminants that have made their way into the fabric and padding of the PPE.

Those chemicals, chemical compounds, and carcinogens that are gases in their physical state, penetrate the vapor barrier and get up under a firefighters PPE because that PPE is not designed, constructed, or rated to stop such exposure from gases.

Your structural firefighting gear is designed to protect you from the physical and thermal threats, but not from those gaseous threats. So, starting right now today it's in every firefighter's best interest to protect themselves to the best of their ability from these threats to their health.

Even PPE that's been properly laundered and dried is not 100% clean. Research is telling us that the perfluorooctanoic acid (PFOA) present in brand [new PPE coats and trousers is a cancer threat](#) (Our European fire service colleagues have already forced PPE manufacturers to eliminate PFOA's in the PPE they produce for use in Europe. Where is the NEPA on this in the US? Crickets).

[See Related: Fire Retardants and their impact on firefighter health](#)

Everybody is now starting to say, "Treat every structure fire like a hazmat incident" (Something I've been saying and writing about for about four or five years now). Well, do you ever see a hazmat team member wearing a Level A (fully encapsulated) protective suit unless they're working on an incident or training? No, you don't! And it's time every firefighter starts looking at their structural PPE the same way!

Here are 4 things firefighters need to stop doing today:

1. Stop wearing PPE any time before they get to the emergency scene. Yes, I'm saying everyone should don their PPE and SCBA [after they arrive at the scene](#). Firefighters and their PPE should never be together in the crew cab of the fire apparatus ever again.

Every firefighter should be able to don all their PPE and SCBA in 90 seconds or less, right?

They had to do it as part of their firefighter certification testing, no? So, 90 seconds is 90 seconds whether it's in the fire station or at the fire scene.

2. Stop wearing any of the structural PPE ensemble as a "convenience." It's easy to just put on your turnout coat when it's cold or raining for that EMS call, but it needs to stop. Fire departments must provide their personnel with clothing and [PPE options](#) instead of relying on structural firefighting turnout gear as the sole option.

[See Related: Structural firefighters need wildland firefighting PPE, too](#)

3. When you're training, get out of all of your gear when breaking for lunch. When taking rehab breaks, get your coat and hood off

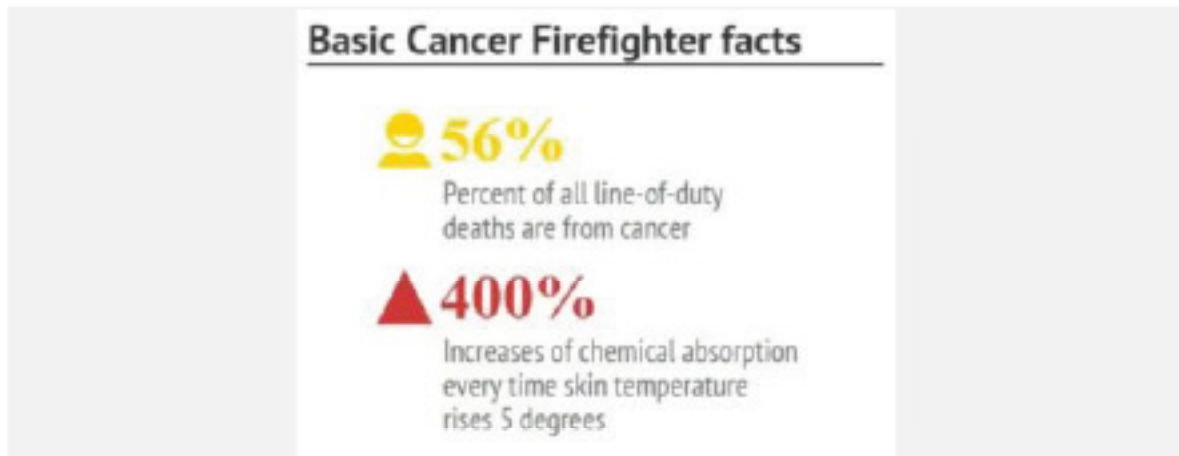


Photo Source: <https://frontlinerehab.com/firefighters-cancer-risk/>

and push your pants down to the boots if removing them is not practical. You must get your contaminated PPE components away from your skin and truly cool your skin temperature. For every five degree rise in skin temperature, absorption through the skin increases by 400 percent!

4. Which leads me to my final point. Stop wearing your PPE while doing PT (physical training). It's bad enough that you're having to wear that PPE during firefighting operations. Why would you continue to put yourself into PPE, work up a good sweat, and absorb whatever is still in your gear?

Wait. There's one more. Stop using your turnout gear as photo props! Every time I see a new baby in a firefighter helmet, or engagement announcements featuring one or both of the couple wearing a helmet and turnout gear coat, I just want to scream!

Your structural firefighting protective ensemble has one purpose and one purpose only: protect you from the physical and thermal hazards of interior structural firefighting. Every firefighter and fire officer in the U.S. and Canada need to make these changes in how they use that protective ensemble.

It is not the strongest or the most intelligent who will survive but those who can best manage change. —Charles Darwin

[Previous Musings about firefighter recruitment and retention](#)

[Next Some Winter Weather Posts to Get You and Your Department Through to Spring!](#)

ABOUT ROBERT AVSEC, EXECUTIVE FIRE OFFICER



Battalion Chief (Ret.) Robert Avsec served with the men and women of the Chesterfield County (VA) Fire and EMS Department for 26 years. He's now using his acquired knowledge, skills, and experiences as a freelance writer for FireRescue1.com and as the "blogger in chief" for this blog. Chief Avsec and his wife of 30+ years now make their home in Cross Lanes, WV. [Contact him via e-mail, rpull157@gmail.com](mailto:rpull157@gmail.com).

Non-structural firefighter PPE

From EMS calls to wildland firefighting, today's firefighters face more than just structural interior firefighting

Nov 6, 2018

...

"One size does not fit all" is one of the more ubiquitous phrases in today's lexicon, and, one of the most obvious, right? So, why should one set of **personal protective equipment** be the "best fit" for all emergencies that firefighters respond to?

NFPA 1971: Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, is the standard on protective ensembles for structural firefighting and proximity firefighting, not the standard on the protective ensemble for *all* firefighter responses.

The protective ensemble that we commonly refer to as turnout gear is specifically designed to protect the wearer from the mechanical and thermal hazards of structural and interior structural firefighting.



Fire departments should consider providing PPE options for their personnel that provide a better balance between protection and comfort when they respond to non-structural firefighting calls for service. (Photo/USAF)

RELATED ARTICLES

- Structural firefighters need wildland firefighting PPE, too
- How to increase firefighter PPE and SCBA compliance
- On the line: First-hand accounts of the devastating summer of 2018 wildfires

CALL VARIETY DICTATES DIFFERING PPE REQUIREMENTS

Today's firefighters respond to a variety of emergencies. Only a small percentage of the calls they respond to require interior structural firefighting. So, shouldn't firefighters have more than one PPE option? Here are two examples where structural firefighting PPE may not be required:

1. **Fire-based EMS calls.** Looking at the most prevalent call type for most fire departments today – **EMS calls** – how many firefighters are entering a patient's home or their place of business while wearing their structural PPE, even if it's only the bunker pants and boots? Yet, our developing body of knowledge for **firefighting exposure** and cancer has led to a new best practice of keeping all structural firefighting PPE elements out of all living areas of the fire station, including the dormitory areas. Don't our citizens deserve similar protection?
2. **Wildland firefighting.** Many fire departments are now finding their personnel engaging in wildland firefighting, particularly **in the wildland urban interface** as residential development continues to encroach on those areas. Some elements of the structural firefighting ensemble could create an undue risk of heat related injuries for firefighters in the WUI, not to mention the extra weight of that gear that takes a toll on a firefighter working to construct a fire line.

That structural PPE package is designed primarily to keep the hostile heat out while dissipating some of the internal heat being generated by the firefighter wearing it. Today's structural PPE does an excellent job for the former but only a fair job for the latter. Firefighter heat stress caused by that internal heat buildup is a real hazard, especially when the ambient outdoor temperature and humidity levels are high.

FIREFIGHTER PPE OPTIONS TO CONSIDER

Fire departments should consider providing PPE options for their personnel that provide a better balance between protection and comfort when they respond to non-structural

firefighting calls for service. One option would be a layered approach combining flame-resistant and cut-resistant clothing to provide a firefighter with protection from possible flame contact along with cut and abrasion protection.

Station uniforms constructed with flame-resistant fabrics have made great strides in recent years in wearability, durability and appearance. The most commonly used fabrics are Nomex IIIA and modacrylic blends.

A second layer of protection can be achieved using coveralls, jumpsuits or a jacket and pants combination, like those used by wildland firefighters. When properly sized for the individual firefighter, either option could easily be donned over the station uniform to provide external protection during non-structural firefighting operations.

A firefighter could be outfitted with coveralls or a jacket and pants ensemble relatively inexpensively, giving them a second PPE option. That option would be more cost-effective for their department and would provide them with the protection they need, while reducing the potential for heat stress and giving them greater comfort and wearability.

About the author

Sponsored by [Globe](#)

Batt. Chief Robert Avsec (Ret.) served with the Chesterfield (Va.) Fire & EMS Department for 26 years. He was an instructor for fire, EMS, and hazardous materials courses at the local, state and federal levels, which included more than 10 years with the National Fire Academy. Chief Avsec earned his bachelor's degree from the University of Cincinnati and his master's degree in executive fire service leadership from Grand Canyon University. He is a 2001 graduate of the National Fire Academy's EFO Program. Contact Robert at Robert.Avsec@FireRescue1.com. The views of the author do not necessarily reflect those of the sponsor.

CASE STUDY: STATE OF KANSAS

Preferred Operating Procedures: Carcinogen Toxin Exposure Reduction

SCOPE: These preferred operating procedures have been developed to reduce the risk and incidence of personnel contracting cancer and other related medical issues. Respiratory protection during an emergency incident is a critical first step to preventing immediate injuries or longer-term medical conditions such as cancer(s). Toxins and Carcinogens in smoke are absorbed into the human body through the skin. PPE (turnouts, hood, helmet, gloves, SCBA, etc.) continue to off-gas carcinogens and other toxins from smoke exposure until they have been adequately decontaminated. These methods are consistent with the tactics and strategy philosophy of the [Your Department Here](#). It is not all-inclusive and cannot cover all the possible situations that personnel may encounter. If conditions warrant, officers and other personnel may deviate from these methods to fit a particular incident or condition.

PERSONAL PROTECTIVE EQUIPMENT

It is widely accepted that our PPE may be a primary exposure to carcinogens and other toxins in the fire service. To combat this [Your Department Here](#) has made a significant investment into the PPE garment(s) issued to our firefighters.

*The Personal Protective Equipment (PPE) will consist of NFPA compliant structural firefighting gear coats and pants, NFPA alternative PPE (1977, 1951,) particulate barrier hoods, gloves, helmet, and boots.

The turnout gear ensemble will only be worn on fire responses such as structure fires, car fires, dumpster fires, etc. In other words, any fire that contains substances other than grass or untreated wood. The gear will be kept clean and ready for use. After each use, it will be decontaminated. If unable or impractical to decontaminate after each use, the gear will be carried bagged in a department issue gear bag to limit the spread of contamination.

*Every firefighter has also been issued their own SCBA mask and/or regulator.

*Along with the structural firefighting gear personnel have also been assigned an NFPA compliant Dual Certified Rescue/Wildland ensemble of gear. This consists of both a coat and pair of pants which affords basic cut protection, limited flash protection, and identification in an easy to launder package.

The Rescue/Wildland (Alternative PPE NFPA 1951, 1977) gear can be used on all other calls which do not involve fire.

VEHICLE EXHAUST

Another common exposure to carcinogens in the fire service comes from exposure to diesel exhaust. The [Your Department Here](#) has installed an exhaust ventilation system for all vehi-

cles in the apparatus bay. All vehicles while sitting in the bay will have their exhaust systems attached to this system.

(Alternate for stations without exhaust systems) All PPE will be kept physically separate from areas with direct apparatus exhaust contamination. Apparatus bays will be open and fully vented possible when running engines. No prolonged running of any gas, diesel motor, or engine will be permitted inside of the station.

INCIDENT RESPONSE / LIVE FIRE TRAINING

Any incident that involves direct or indirect smoke exposure, personnel will utilize SCBA for respiratory protection. Circumstances include (but are not limited to):

interior/exterior fire suppression (other than wildland), vehicle fires, dumpster fires, cooking fires, and any training evolutions where smoke is present.

Personnel will utilize SCBA protection during ongoing fire suppression efforts and during overhaul operations, assuming that they are in the immediate IDLH atmosphere.

Fire investigators should also wear SCBA or other accepted respiratory protection while completing investigations.

The incident commander will determine when SCBA use can be discontinued. It is again understood that contaminants are still at high levels during the overhaul phase of the fire. Discontinuation of SCBA use will more than likely require air monitoring of the area. [Your Department Here](#) has the capability to monitor Hydrogen Cyanide, Oxygen levels, Lower Explosive Limits, Carbon Monoxide, and Hydrogen Sulfide. Even with this capability, we understand that there could be other contaminant(s) present.

DECONTAMINATION AT THE SCENE

After smoke exposure, [Your Department Here](#) personnel will undergo gross field decontamination of their PPE's exterior (i.e., turnouts, boots, helmet, SCBA harness/straps/mask) to remove as much soot and particulates as possible. This can be accomplished by spraying PPE with a booster/forestry line and using a scrub brush. Doing so will rinse off smoke particulates and minimize that level of carcinogens that are off gassed from contaminated PPE. Once the garment is washed down the firefighter will disrobe his turnout gear into a trash bag and secure the garments (when practical). The firefighter should then place his reserve set of structural gear in service until the primary gear is cleaned and decontaminated properly.

During incidents of extreme weather conditions or high call volume that preclude the above-mentioned gross decontamination and bagging, the Structural PPE should be placed into the department-issued gear bag for transport and possible immediate use. This gear bag shall be laundered in accordance with department policy when the gear is cleaned.

While wearing medical gloves, personnel will use body wipes to remove carcinogens from the most vascular areas of their skin (i.e., face, head, neck, jaw, throat, underarms, groin [if possible], and hands). If possible, wash hands and face with water and a degreasing soap (i.e., Dawn™ dish soap) prior to leaving the scene.

Preferred Method: If possible, the bags of contaminated gear should be transported back to the station outside the Passenger Compartment of the apparatus.

DECONTAMINATION AT THE FIRE STATION

Upon returning to the station, [Your Department Here](#) personnel should shower as soon as possible with a degreasing soap. It is preferable to first shower with cold water, as to not open the skin's pores. After a cold shower, warm/hot water can be used.

Personnel will launder all contaminated personal clothing (i.e., station wear) immediately after showering.

Personnel will launder all contaminated PPE in an extraction washer using the "Turnout Gear" selection and an NFPA 1851-approved detergent. This includes turnout coats and pants, gloves, and hoods. Launder PPE according to the manufacturer's instructions. Personnel shall utilize their spare set of firefighting PPE until their frontline PPE is decontaminated and dry.

Personnel will use a damp, soapy cloth to clean all other items from their PPE that may not withstand full water immersion (i.e., helmet liner, inside of helmet, thermal imaging camera, portable radio and strap, flashlight, SCBA mask, etc.). When directly handling contaminated equipment/PPE, personnel should wear medical gloves.

On a weekly basis, personnel will use damp, soapy cloths to decontaminate affected areas of the apparatus' passenger compartment (i.e., seats, doghouse, headsets, etc.). As a rule of thumb, if any equipment smells of smoke, it is "contaminated" and shall be decontaminated as soon as possible.

CASE STUDY: BRENTWOOD FIRE & RESCUE

Brentwood Fire & Rescue Department – General Operating Guidelines		
SUBJECT: Lightweight Turnout Gear		Number: 311
Draft Date: 6-17-2013	Comment Date:	Revision Date: 10-14-2013
Effective Date: 6-20-2013	Review Date: 11/15/18	Page: 1 of 3

SCOPE

This guideline applies to all Brentwood Fire & Rescue Department personnel.

PURPOSE

The Fire & Rescue Department has identified heat stress as a key risk factor facing our personnel. In fact, exposure to high ambient temperatures like those experienced here in Middle Tennessee (even apart from structure fire situations) has been recognized nationally as the leading causative factor in firefighter injury and death. One of the most effective methods for the reduction of core body heat is the use of lightweight clothing, including turnout gear. Lightweight turnout gear (LTG), also referred to as extrication or wildland gear, provides a highly desirable alternative to structural turnout gear for incidents where gear is required but where a more appropriate level of protection would be practical or even preferred. LTG provides protection against the thermal and physical hazards encountered at most outdoor non-structural incidents while affording three times the Total Heat Loss (THL) at a fraction of the weight (7 lbs.) compared to structural turnout gear (21 lbs.).

The purpose of this guideline is to establish protocols for the selection and use of lightweight turnout gear and to maintain safety and consistency in appearance among all Brentwood Fire & Rescue Department personnel.

DEFINITIONS

Reserved

RESPONSIBILITIES

Reserved

PROCEDURE

Beginning July 1, 2013 the Brentwood Fire & Rescue Department will provide each member with lightweight turnout gear (LTG) which provides protection from the hazards of the work environment to which the member may be exposed. Such protective clothing and equipment will be suitable for the tasks which the member is expected to perform in that environment. Department issued PPE and equipment shall only be used by personnel when acting within the scope of their responsibilities as a Brentwood firefighter unless otherwise approved by a Chief Officer.

Members will be fully educated in the care, use, maintenance and limitations of the protective clothing and protective equipment assigned to them or available for their use. Lightweight PPE and protective equipment will be used and maintained in accordance with manufacturers' instructions and the maintenance and inspection program of the Brentwood Fire & Rescue Department. Washing instructions can be found on the tag affixed to the garment as well as in Guideline #304 PPE Inspection and Maintenance.

Brentwood Fire & Rescue Department – General Operating Guidelines

SUBJECT: Lightweight Turnout Gear		Number: 311
Draft Date: 6-17-2013	Comment Date:	Revision Date: 10-14-2013
Effective Date: 6-20-2013	Review Date: 11/15/18	Page: 2 of 3

Department Issued Lightweight PPE

All members who may be engaged in or exposed to the hazards of technical rescue and non-structural firefighting will be provided with:

- Protective coats that meet the requirements of both NFPA 1877-2005, Standard on Protective Clothing and Equipment for Wildland Firefighting and NFPA 1851-2007, Standard on Protective Ensembles for Technical Rescue Incidents. The standard clothing color will be tan material with lime-yellow triple trim.
- Protective trousers that meet the requirements of both NFPA 1877-2005, Standard on Protective Clothing and Equipment for Wildland Firefighting and NFPA 1851-2007, Standard on Protective Ensembles for Technical Rescue Incidents. The standard clothing color will be tan material with lime-yellow triple trim.
- Helmets that meet the requirements of NFPA 1972, Standard on Structural Firefighters' Helmets. Currently the Cairns 1D44 is the departmental-issued model. Alternatively, technical rescue helmets meeting the ANSI Z89.1-2003 standard are acceptable for non-fire incidents.
- Gloves that meet the requirements of NFPA 1873, Standard on Gloves for Structural Firefighters. "Extrication Gloves" and leather gloves supplied by the Department are acceptable for technical rescue incidents and other non-fire situations at the discretion of the company officer or incident commander.
- Footwear that meets the Department's definition of a "wildland boot" which possesses all of the following components:
 - Black in color
 - Minimum 8" height from bottom of sole to top edge of boot
 - Lace-up (with or without zipper)
 - Steel or composite reinforced toe
 - Vibram or similar "lug" sole
- Protective hoods that provide protection for the ears and neck as needed.

Proper Use of Lightweight PPE

For the purposes of this section, *full protective clothing or full PPE* consists of turnout coat, bunker pants, wildland boots, helmet with face shield or goggles, and structural firefighting or extrication gloves. PPE must always be worn in accordance with manufacturer's recommendations.

LTG may be utilized for such incidents include all non-structural fires (vehicle, trash, brush & grass) as well as vehicle extrications, service calls, technical and other rescues. Under no circumstances should LTG be donned when responding to a reported structure fire, inside investigation, or fires reported to be in close proximity to a structure such as awning, car in a driveway, deck, etc. where a reasonable expectation of extension to the structure exists. Members found wearing LTG in these situations will be subject to formal discipline.

Personnel should be aware that LTG does not provide bloodborne pathogen protection and that Tyvek clothing is provided for that purpose.

Brentwood Fire & Rescue Department – General Operating Guidelines

SUBJECT: Lightweight Turnout Gear		Number: 311
Draft Date: 6-17-2013	Comment Date:	Revision Date: 10-14-2013
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All personnel shall carry their LTG on board the apparatus while on duty. Wildland boots may be carried as part of the LTG or worn routinely as a dual-purpose duty boot.

Officers shall authorize the use of LTG based upon the risk factors outlined in the PURPOSE section above, and within the parameters specified under Proper Use of Lightweight PPE. As a general rule use of LTG should always be considered within these specified parameters, but principally when the ambient temperature exceeds 70 degrees.

The helmet face shield or attached goggles will be utilized at any time the need for eye protection exists. Examples may include while operating hand or power tools and when fighting grass or any other outside fire where the SCBA face piece is not being used.

The appropriate type of glove will be worn when engaged in firefighting, using hand and power tools, servicing fire hydrants, or any other situation where the potential for hand injury exists. The structural firefighting glove is the only acceptable glove to be worn during fire suppression activities.

At a minimum, safety vests and helmets will be worn while directing or operating around moving traffic except when involved in fire suppression activities. In these cases full PPE is required and the vest may be doffed.

How Cy-Fair VFD's new gear reduced firefighter heat stress and recovery time

The department improved firefighter recovery time and decreased the incidence of heat stress with versatile new gear from the **TECGEN PPE** brand

Dec 5, 2014

*The following is sponsored content from the **TECGEN PPE** brand**

By FireRescue1 Staff

Background: Located in the greater Houston area, the Cy-Fair Volunteer fire department serves a population of over 400,000 residents spread over approximately 180 square miles. With 12 stations and services that include EMS, dispatching and fire suppression, they are one of the largest multiservice fire departments in North America.



(photo courtesy of Cy-Fair Volunteer Fire Department)

The department responds to nearly 25,000 calls per year with a staff of 200 full- and part-time employees and 350 volunteer firefighters. With an area that ranges from farmland to suburban neighborhoods and light and heavy commercial development, they are required to perform a wide variety of duties that requires them to use wildland fire gear as well as rescue gear on a regular basis.

Problem: In the summer months, the heat and humidity in the Houston area can be unforgiving. The heat index routinely hits 105° F or more. Traditional bunker gear is made specifically for thermal protection, not for breathability.

In the heat and humidity of a Texas summer, gear that lacks breathability can cause tremendous heat stress for firefighters. Recovery time after incidents also increases in the hot months.

In addition, the varied nature of the community they serve, from rural to suburban, wildland and rescue, means that the Cy-Fair VFD needed gear that could make that transition while still affording excellent protection.

They needed an alternative to bunker gear that would provide protection without putting firefighters at undue risk of heat-related ailments, and it had to be comfortable enough to wear for hours.

Solution: The Cy-Fair VFD needed gear that would meet their needs not just now but 10 to 20 years down the road, as the community they served continued to change and develop. To accomplish this, they worked with the TECGEN PPE brand to provide gear that would meet all of their needs.

After a series of trials, TECGEN gear exceeded the specifications originally set by the Cy-Fair VFD. TECGEN PPE is dual-certified for wildland fire as well as rescue, so it was able to serve the department's needs in both applications. In addition, the ease of use of the TECGEN gear was notable, allowing volunteers to easily slip it on over their clothes. The lighter, less cumbersome TECGEN gear was more breathable, and thus more comfortable and easily adapted to many of the types of calls the department made.


Results: The results of adopting the TECGEN garments were seen immediately. The recovery times for firefighters after calls were reduced. There were also fewer reports of heat stress in both rescue and wildland environments when the TECGEN gear was used.

Beyond the benefits to individual firefighters, there were other benefits. Due to the use of the TECGEN garments, there was less wear and tear on the much more expensive structural gear that might have been used in situations where the versatile TECGEN gear was now used. The department expects to save money long term by extending the life of their structural gear.

"Overall, the gear is a big improvement over the old ones, especially in the summer weather," said Steven Witt, Assistant Chief #34, Cy-Fair VFD.

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CASE STUDY: HANOVER PARK FIRE DEPARTMENT

SOG-200-013 Personal Protective Clothing	
	HANOVER PARK FIRE DEPARTMENT STANDARD OPERATING GUIDELINES
TITLE: Personal Protective Clothing	SECTION/TOPIC: Operations
NUMBER: SOG-200-013	ISSUE DATE: 05/26/2006
	REVISED DATE: <ul style="list-style-type: none">▪ 04/19/2017▪ 12/06/18
FIRE CHIEF CRAIG A. HAIGH APPROVAL:	
These SOGs are based on FEMA guidelines FA-197	

1.0 POLICY REFERENCE

NFPA	▪ NFPA 1851- Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting.
NIMS	

2.0 PURPOSE

For the physical safety of department personnel, members are provided with personal protective equipment. This policy addresses at a minimum the selection, care, maintenance, inspection, cleaning, storage, and record keeping along with generalized usage policies designed to provide protection to operating members. Members/users of Personal Protective Equipment (PPE) need to be cognizant that all PPE has limitations and will not protect members from all incidents of injury or health concerns.

This standard operating guideline addresses personal protective equipment. The primary objective is to reduce the safety and health risks associated with improper selection, poor maintenance, inadequate care, excess wear and improper use of PPE consistent with NFPA 1851.

3.0 SCOPE

This guideline shall apply to all activities of the Hanover Park Fire Department, including, but not limited to, fire ground operations, EMS operations, training exercises and drills.

4.0 DEFINITIONS

Advanced Cleaning: The thorough cleaning of ensembles or elements by washing with cleaning agents.

Drag Rescue Device (DRD): A component integrated within the protective coat element to aid in the rescue of an incapacitated fire fighter.

Ensemble Elements: The compliant products that provide protection to the upper and lower torso, arms, legs, head, hands and feet.

Hazardous Materials (HazMat): Substances that when released are capable of creating harm to people, the environment, and property.

Independent Service Provider: A service provider verified by a third-party certification organization to conduct any one or a combination of advanced inspection, advanced cleaning, basic repair, or advanced repair service.

Routine Cleaning: The light cleaning of ensembles or ensemble elements performed by the end user without taking the elements out of service.

Service Life: The period for which compliant product can be useful before retirement.

Structural Fire Fighting: The activities of rescue, fire suppression, and property conservation in buildings, enclosed structures, vehicles, marine vessels, or like properties that are involved in a fire or emergency.

Structural Fire-Fighting Protective Ensemble: Multiple elements of compliant protective clothing and equipment that when worn together provide protection from some risks, but not all risks, of emergency incident operations.

Shall: Indicates a mandatory requirement.

Should: Indicates a recommendation or that which is advised but not required.

5.0 GUIDELINES & INFORMATION**Responsibilities**

Supervisors shall be responsible for training the members of their crew(s) in the care, use, inspection, maintenance, and limitations of assigned personal protective equipment (PPE). Company Officers and Incident Commanders shall be responsible for ensuring that all personnel under their command adhere to these policies.

Selection of Department PPE

Prior to procurement, a risk assessment shall be performed, and consideration given to the following:

- PPE performance expectations to include thermal and physiological effects.
- Style and design for user comfort and wear performance.
- Construction for quality, durability and garment service life.
- Manufacturer capabilities to meet department performance demands, technical information, service, warranty and customer support.

Training

New fire fighters will receive training on the care, use and maintenance of their assigned PPE before being allowed to participate in training or operations including live fire training.

Whenever ensembles or ensemble components are replaced, changed or improved all department members shall receive additional training in the care, use and maintenance of their assigned PPE.

Protective Ensemble

The mission of PPE is to provide the user an envelope of protection from multiple hazards and repeated exposures. A protective ensemble is clothing and equipment that when worn together provide protection from some risks, but not all risks, of emergency incident operations. A present-day protective ensemble consists of a helmet, hood, jacket, trousers, gloves, eye protection, and footwear.

Types and definitions of approved Department Protective Ensembles:

- **Full Turnout Gear:** Helmet, hood, fire coat, gloves, fire pants with boots and self-contained breathing apparatus (SCBA).
- **Hybrid Turnout Gear:** Helmet, hood, technical rescue coat, extrication gloves, technical rescue pants with boots.
- **Work Uniform / Station Wear:** As specified by Incident Command when limited to no risk exists.
- **Hazardous Materials (HazMat) Gear:** Appropriate level of protection will be determined by the HazMat Safety Officer and/or the Incident Commander.

Usage

All personnel, except Chief Officers, shall don the required PPE for the emergency prior to boarding the apparatus. Chief Officers shall don the required and situational PPE prior to reporting to the Incident Command Post.

All personnel who are directly engaged in emergency operations or can reasonably anticipate that they may become involved on short notice, shall be attired in a PPE ensemble specific to the incident type detailed in the PPE Chart of Required Personal Protective Equipment.

If a response is dispatched while the apparatus is in motion, the engineer, when safe to do so, shall pull to a safe location and allow personnel to don their PPE. At no time shall personnel remove seatbelts to don PPE or wear structural firefighting helmets while the apparatus is in motion.

Any Department personnel performing testing or training shall wear a level of PPE that is appropriate for the testing or training scenario.

All fire apparatus engineers, when out of the driver's seat and working on or around the apparatus at an emergency incident, shall be attired in the level of PPE required of other firefighters for the incident type. A SCBA does not have to be worn but must be immediately available for use if required. A combination of structural and hybrid gear can be worn by engineers operating apparatus at the discretion of the company officer.

Personnel who are directly involved in providing patient care shall don the required PPE prior to contacting the patient.

If Hybrid Turnout Gear is the required PPE for an incident response, full turnout gear shall accompany personnel.

Hybrid turnout gear may be left at the station should the incident require only full turnout gear i.e. structural fires. Upon return to the fire station hybrid gear shall be returned to a ready state.

Minimum PPE requirements for different incident types can be found as an attachment to this document.

Routine Inspections

Individual members shall conduct a routine inspection of their protective ensembles and individual ensemble elements after each use for the following:

- Soiling
- Contamination
- Physical damage such as rips, tears, and cuts
- Damaged or missing hardware and components
- Thermal damage such as charring, burn holes, melting, discoloration
- Damaged or missing reflective trim
- Loss of seam integrity and broken or missing stitches
- Correct assembly of the shell, liner and DRD device
- Loss of face opening adjustment on fire hoods
- Shrinkage, loss of flexibility, and inverted liners for gloves
- Exposed protective toe, mid-sole or shank for boots
- Loss of water resistance for boots

DRD components shall be inspected for the following:

- Correct installation in the garment.
- Soiling
- Contamination
- Physical damage such as cuts, tears, punctures, cracking or splitting
- Thermal damage such as charring, burn holes, melting, discoloration
- Loss of seam integrity and broken or missing stitches

Advanced Inspections

Advanced inspections shall be conducted when routine inspections indicate that a problem could exist and shall be performed by the equipment manufacturer or a verified independent service provider.

Advanced inspections shall be documented electronically in FIREHOUSE Software® and records kept for the service life of the protective ensemble.

Monthly Inspections

Company Officers shall conduct a routine inspection of their subordinates' protective ensembles and individual ensemble elements the first Sunday of each month.

Monthly Inspections shall be documented electronically in FIREHOUSE Software®.

Gross Decontamination

Gross decontamination shall take place when turnout gear becomes contaminated or soiled after usage and should take place before members enter their vehicle to return to quarters to minimize contamination of the interior cab area.

Fire fighters are encouraged to always bring their duty shoes/boots along with them to the incident for purposes of wearing back to the station after they remove their gear.

Procedure for on-scene gross decontamination:

- Crew assembles in an area free of traffic or other hazards.
- The crew shall remain in their PPE, including SCBA and go through a very simple decontamination using a stiff bristled brush and a fresh water rinse. Heavy scrubbing or spraying with high velocity water jets, such as a power washer or pressurized hose line, shall not be used.
- After the member has been washed and rinsed from head to toe, the member should doff the PPE.
- Heavily soiled or contaminated gear shall be removed after gross contamination, placed into a clear plastic bag, and transported using a utility vehicle or placed in an outside apparatus compartment.
- Decontamination wipes shall then be used to clean the face, head and neck area as well as the hands.

Members should shower and don clean uniforms/clothes as soon as possible upon return to quarters.

Fire fighters shall switch to their second set of structural turnout gear, including second protective hood and gloves, or advise their company officer to arrange for a spare set to be used from the quartermaster cache.

Gross decontaminated gear shall be removed from the plastic bags and timely laundering completed.

Routine Cleaning and Laundering

Each fire fighter shall be responsible for the routine laundering of their issued PPE using department provided specialized equipment used to wash and decontaminate turnout gear according to manufacturer's recommendations.

Chlorine bleach or chlorinated solvents shall not be used to clean or decontaminate PPE ensembles.

Soiled or contaminated PPE ensembles shall not be brought home, washed in home laundries or washed in public laundries unless specified to handle firefighting protective clothing. Commercial dry cleaners shall not be used.

All PPE Ensembles shall be cleaned and decontaminated at a minimum bi-annually. Ensembles shall be washed when soiled with by-products of combustion, human bodily fluids or hazardous material exposure.

Protective hood and gloves shall not be worn without first being laundered.

Shells and liners shall be separated, and machine washed with similar layers to avoid cross contamination.

The DRD shall be removed prior to coat cleaning and inspected. If the DRD requires cleaning it shall be placed in a separate mesh bag for washing.

Turnout gear shall not be dried using tumbling or agitation. All closures shall be fastened prior to placing gear in dryer.

Documentation of turnout gear laundering shall be documented using FIREHOUSE Software[®].

Live Fire Training Cleaning Procedures

Following bi-annual live fire training, personnel shall be responsible for laundering the turnout gear of the shift that precedes them. Part-time fire fighters shall make their turnouts available for cleaning during this period.

Personnel shall empty pockets of personal items and leave them in their assigned gear storage locker.

Bailout components and rope shall be laid out for natural drying if wet.

Cleaning shall be performed as outlined in the above section titled Routine Cleaning and Laundering.

Each fire fighter shall be responsible for re-assembling and inspecting their PPE for use after cleaning.

Repair of PPE Ensembles

Full Turnout Gear that is found to be damaged or deficient following use or during normal inspection schedules shall be taken out of service and non-destructively tagged with where the problem is located. The effected fire fighter shall move into their second set of Full Turnout Gear. If the fire fighter does not have a second set of Full Turnout Gear, they will be given a temporary replacement from the quartermaster cache.

Attachment 1

Hybrid Turnout Gear that is found to be damaged or deficient following use or during normal inspection schedules shall be taken out of service and non-destructively tagged with where the problem is located. The fire fighter will be given a temporary Hybrid Turnout Gear replacement from the quartermaster cache. If no replacement Hybrid Turnout Gear is available, the fire fighter will wear Full Turnout Gear for all responses that Hybrid Turnout Gear would be the required PPE until his/her set of Hybrid Turnout Gear is repaired and placed back into service.

Any time a PPE Ensemble is removed from service the Department Quartermaster shall be notified so they can inspect the gear and take the appropriate action to schedule repair. Documentation shall also be made in FIREHOUSE Software[®].

Storage of PPE Ensembles

Full and Hybrid Turnout Gear shall not be stored in direct sunlight or exposed to direct sunlight when not being worn. When placing gear ensembles in storage areas they shall be clean and dry before storage.

Full and Hybrid Turnout gear shall not be stored in living areas or in contact with hydraulic fluids, solvents, hydrocarbons, vapors, or other contaminants.

Retirement of PPE

The Department shall retire PPE ensembles and elements that are worn, damaged or contaminated to the extent the Department deems it not possible or cost effective to repair. Ensembles and elements that are no longer serviceable to the Department for emergency operations and any ensembles and elements that are not in compliance with the NFPA standard at the date of their manufacture shall be retired.

Turnout gear shall be removed from service ten (10) years after the date of manufacture and either destroyed or disposed of to prevent any potential use for firefighting or emergency activities, including live fire training.

Severe Injury and Fatality Procedures

Following a severe injury or fatality to a firefighter, company officers shall immediately remove the PPE from service and preserve all components of the turnout gear ensemble including SCBA used by the injured or deceased fire fighter.

The turnout gear ensemble, including SCBA, shall not be laundered. All PPE is to be kept in the exact condition in which it is confiscated.

Turnout gear and SCBA shall be non-destructively tagged and secured at a location with controlled, documented access where proper chain of custody will be maintained by the Fire Chief or his/her designee. In the case of a fatality this may include utilization of Hanover Park Police Department Evidence Technicians as stated in the Line-of-Duty Death or Serious Injury Procedure, SOG-200-061.

The affected turnout gear and SCBA shall be stored in a paper or cardboard container to prevent further damage. Plastic containers shall not be used.

Attachment 1

The affected PPE and SCBA shall be made available to qualified members of the Department or outside experts as approved by the Fire Chief, to determine the condition thereof.

Retention time for the custody of the PPE shall be determined by the Fire Chief.

Recordkeeping

The department shall maintain records on all PPE ensembles and elements. Electronic documentation in FIREHOUSE Software® shall include the following:

- Whom equipment was issued to including date and condition.
- Manufacturer's model name, design, identification number, lot number, and serial number, year and month of manufacture.
- All dates of cleaning and monthly PPE inspections.
- All dates of advanced, specialized cleaning or decontamination, including who performed them.
- All date(s) of repairs, including who performed repair, and brief description of the repair performed.
- Date of retirement and method(s) of disposal.

6.0 ATTACHMENTS

1. Chart of Required Personal Protective Equipment

Hanover Park Fire Department Chart of Required Personal Protective Equipment

These PPE requirements are for initial response and operations. Company Officers and/or the Incident Commander may add or reduce PPE based on current or expected scene conditions.

<i>Response Type</i>	<i>Minimum Required PPE</i>	<i>Situational PPE</i>
<ul style="list-style-type: none"> • Structure Fire • Vehicle Fire • Rubbish/dumpster fire • Outside fire w/exposure • Vehicle accident w/fire • Inside smoke investigation • Activated fire alarm • Alarm investigations • Inside odor investigation • Inside gas leak • Live fire training 	<ul style="list-style-type: none"> • Full Turnout Gear including SCBA 	<ul style="list-style-type: none"> • Hearing Protection • Eye Protection • High Visibility Safety Vest
<ul style="list-style-type: none"> • Vehicle accident-no fire • Vehicle accident w/ extrication • Outside fire no exposure • Grass/brush fire • Outside smoke investigation • Outside odor investigation • Carbon monoxide alarm • Generalized investigations • Fuel spills • Flooding • Wire down or arcing 	<ul style="list-style-type: none"> • Hybrid Turnout Gear 	<ul style="list-style-type: none"> • SCBA • Full Turnout Gear • Hearing protection • Eye protection • High visibility safety vest • Work uniform/Station wear • Gloves
<ul style="list-style-type: none"> • Medical emergencies 	<ul style="list-style-type: none"> • Work Uniform / Station Wear • Medical Gloves • Safety Glasses 	<ul style="list-style-type: none"> • Hybrid Turnout Gear • Face Shield • HEPA Mask • Disposable Gown • Hearing Protection
<ul style="list-style-type: none"> • Water rescue (shore operations) 	<ul style="list-style-type: none"> • Work Uniform/Station Wear • Personal Flotation Device (PFD) 	<ul style="list-style-type: none"> • Hybrid Turnout Gear • Determined by Dive Safety Officer and/or Incident Commander
<ul style="list-style-type: none"> • Stuck elevator • Lock out to building 	<ul style="list-style-type: none"> • Work Uniform/Station Wear • Helmet • Gloves 	<ul style="list-style-type: none"> • Hybrid Turnout Gear
<ul style="list-style-type: none"> • Specialty incidents (dive, water, swift water, trench, vertical, hazardous materials) 	<ul style="list-style-type: none"> • Determined by specialty team Safety Officer and/or Incident Commander 	<ul style="list-style-type: none"> • Determined by specialty team Safety Officer and/or Incident Commander

SCBAs are required to be worn and in use anytime you enter a potential IDLH atmosphere and will continue to be worn until the Company Officer or Incident Commander determines that they are no longer required.

CASE STUDY: COPPERAS COVE FIRE DEPARTMENT



Wildland Fire Personal Protective Equipment Implementation Plan

Copperas Cove Fire Department • 2011

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Executive Summary

This proposal seeks to define and quantify the need for the City of Copperas Cove Fire Department to provide Wildland Personal Protective Equipment (PPE) to each member of the Operations Division and lays out an implementation plan to achieve this goal.

The Copperas Cove Fire Department responds to approximately 90 Wildland fires a year, this number nearly doubles during droughts and has recently spiked to as high as one Wildland fire every other day. Even with the high volume of Wildland fires, the Fire Department currently does not provide any Wildland PPE that is safe to wear and in service. Instead the department relies on Firefighters wearing their Structural Fire Protective Equipment instead. The full proposal breaks down, in detail, the statistics of the CCFD and the risks, issues, and liabilities this current strategy in to six major areas.

1. Firefighters are put at even greater risk of physiological stresses, heat stroke, heat exhaustion, and other fatigue related injuries on the fire ground.
2. Firefighters are put at even greater risk of physical injuries due to lack of dexterity, balance, grip, and stability on the often treacherous topography of the Wildland fire ground.
3. Municipalities are spending and wasting tax payer money replacing expensive structural firefighting PPE that is torn, ripped, cut, or otherwise damaged by the rough, sharp, and unforgiving terrain of Wildland fire grounds when compared to the significant cost savings of Wildland specific PPE.
4. Municipalities are at increased civil liability by failing to provide industry standard Wildland specific PPE in the event of firefighter injury or death.
5. Municipalities are at increased internal liability as using structural firefighter PPE for any other purpose that they were designed voids the manufactures warranty, again wasting tax payer money with unnecessary and overpriced repair and replacement costs.

The proposal requests that the Copperas Cove Fire Department address these concerns by providing the best possible equipment to the Firefighters by investing in Teegen Xtreme Wildland PPE. The proposal has researched numerous Wildland PPE and found that Teegen Xtreme will save the department \$17,000 to \$24,000 every five years with a minimal investment of just \$400 per person. Further investing in Teegen Xtreme will provide solutions to all six of the risks, issues, and liabilities associated with the current strategy of wearing Structural Fire Equipment on Wildland Firegrounds.



1. Administration

1.1 Scope

This document (herein called the "proposal") is intended as a proposal to define and quantify a long term plan for the Copperas Cove Fire Department to invest in Wildland Personal Protective Equipment with the goal that by the end of FY 2015 each member of the department is provided with personally assigned Wildland personal protective equipment (herein called "PPE"). At times this proposal will reference the National Protection Association (herein called "NFPA) Codes and Standards. The proposal does so understanding the NFPA represents best practices not laws which are governed by the Texas Commission on Fire Protection.

This proposal will capitalize the word "Wildland" for clarity. Further Wildland fires will be defined, for the purpose of this proposal, to include any and all non-structure fires that occur in the brush, grass, wilderness, forest, and other vegetation areas regardless of ignition, damage, or benefit. Additionally Wildland fires will also include fires fought in the Wildland/Urban interface that do not specifically involve interior offensive structural firefighting in a CCFD defined Immediate Danger to Life and Health atmosphere.

This proposal will include specific standards for Wildland PPE and the quantity in which it shall be distributed. Additionally this proposal will include a quantifiable solution to determining this programs effectiveness over the initial investment period and during the return period.

The proposal is based in the belief that properly equipping firefighters in the right gear for the task at hand will not only provide a cost effective budget saving solution for the city but will provide a safer working environment for firefighters, where they can work harder, longer, and healthier than under the current conditions.

1.2 Purpose

The purpose of this proposal is to clearly define the need for Wildland PPE by the Copperas Cove Fire Department (herein called "CCFD"), the need for individually assigned Wildland PPE, and the most appropriate type of Wildland PPE to incur the greatest long term return for the department.

To achieve this purpose the proposal will delineate both nationally recognized standards and industry best practices to provide a comprehensive scope of knowledge so that CCFD Administration can make an informed recommendation and decision on the long term viability of the proposal.

1.3 Implementation

The proposal in no way seeks implementation prior to full CCFD Administration review, City of Copperas Cove City Staff review, and final approval, funding, and support of the proposal by the City Council of the City of Copperas Cove.

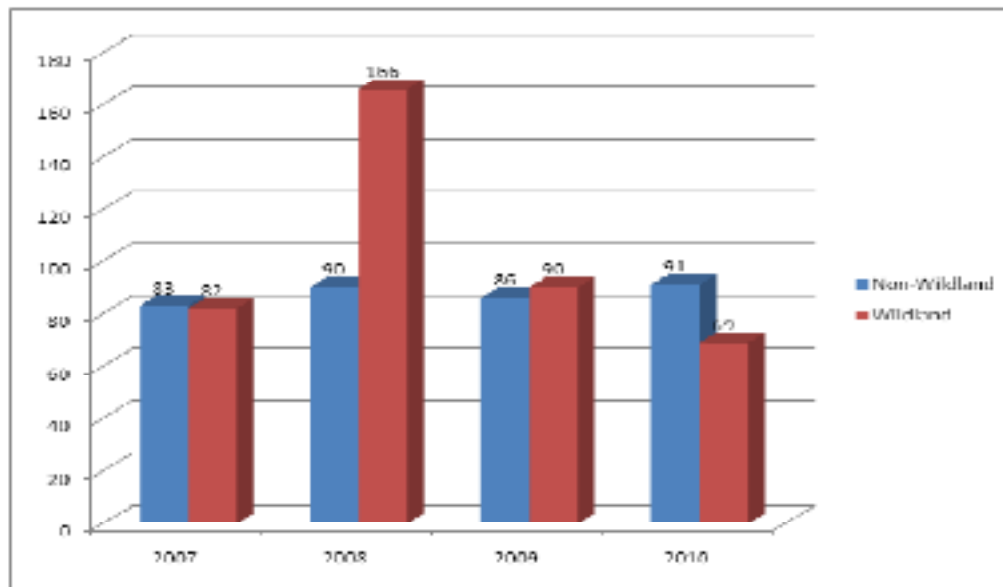
The proposal will delineate specific time frames for implementation and will provide empirical data to support the positive and negative outcomes should those time frames be met or missed. This data is designed to assist CCFD Administration in their research and is in no way designed to or intended to cause implementation of the proposal without full CCFD Administration support and review.

2. Necessity

2.1 *CCFD Alarm History*

The City of Copperas Cove utilizes a computer based NFIRS reporting system known as Firehouse. This system was used to compile the following data.

From 2007 – 2010 CCFD responded to 757 “fire” alarms. These alarms include all NFIRS codes from 100-151. Wildland fires including natural vegetation fires, brush fires, grass fires, outside rubbish and trash fires, and forest fires totaled 407 alarms. Non-Wildland fires including structure fires, car fires, and mobile home fires totaled 350 alarms. On average CCFD responded to 87.5 Non-Wildland fire alarms per year and 101.8 Wildland fire alarms annually.



Calendar year 2008 had a particularly high number of Wildland fires with a total of 166 alarms. This represents a 63% increase over the 4 year average for Wildland fires. While 2010 showed a significant decrease in Wildland fires with just 69 alarms a 32% decrease when compared to the 4 year average. These statistics match historical drought data (see next page for 2008 drought statistics).

Non-Wildland fires maintained a steady 4 year average with a less than 4% increase or decrease in any of the statistical years.

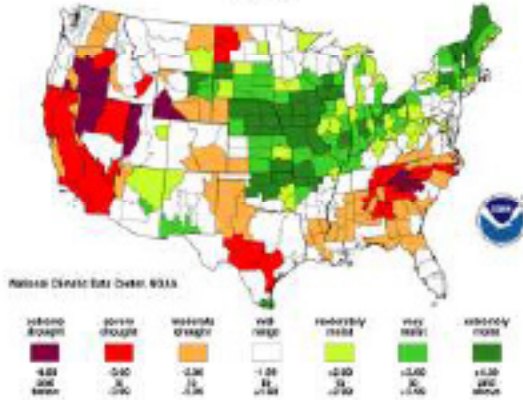
If you removed the 2008 totals from the statistical average then Wildland alarms would average 80 per year and Non-Wildland alarms 86 annually. This would however be an unreliable conclusion as the proposal is designed to not only work off of statistics but also to include the possibility of a heavy and long Wildfire season as was shown by the 2008 data.

From January 1, 2011 to March 19, 2011 CCFD has already responded to 32 Wildland fires, should the number of alarms remain steady for the remainder of the year CCFD will respond to approximately 150 Wildland fires this year.

2008 Drought Data

Palmer Hydrological Drought Index
Long-Term (Hydrological) Conditions

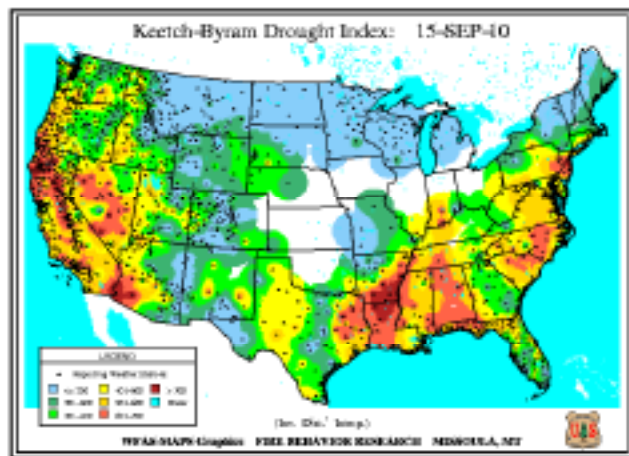
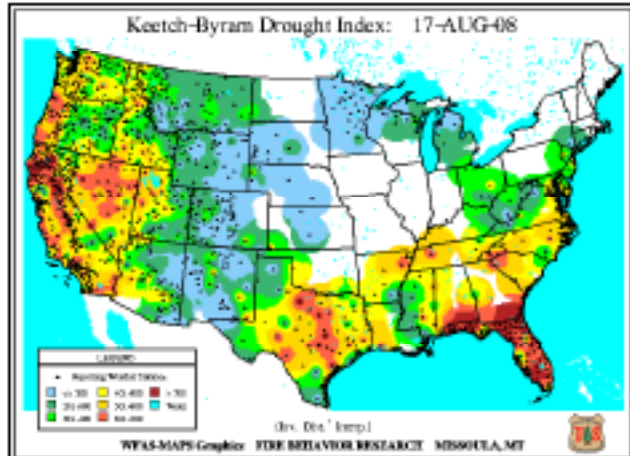
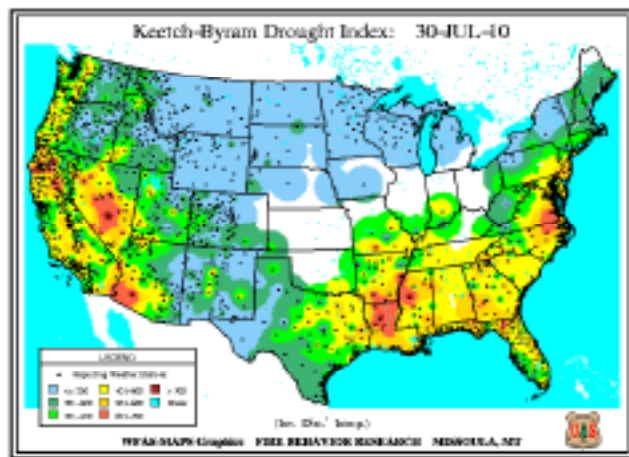
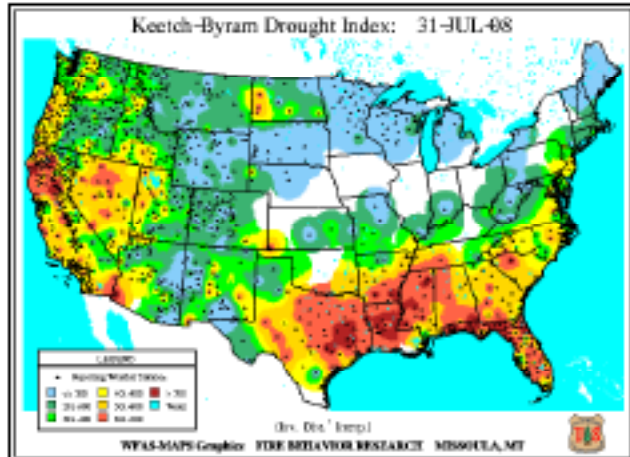
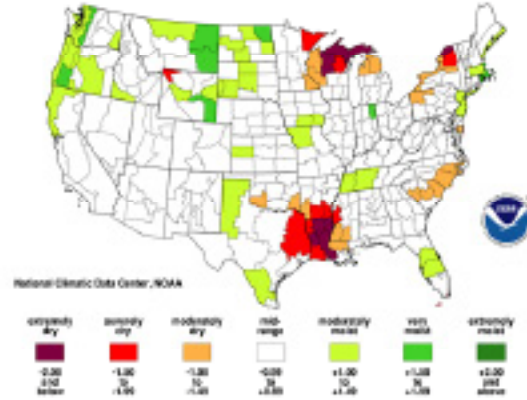
July 2008



2010 Drought Data

Standardized Precipitation Index
Three Months

March-May 2010

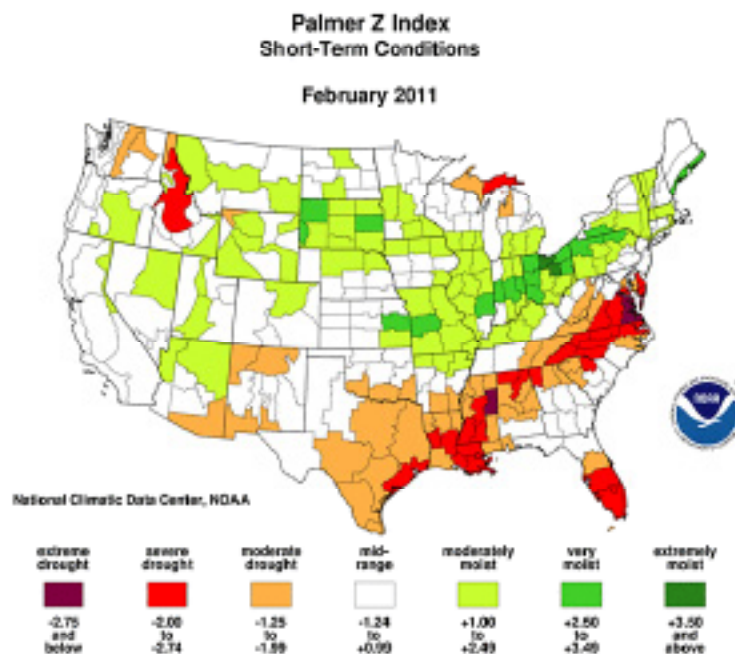


2.2 CCFD Statistical Conclusions

It is the conclusion of the proposal that considering the generally stable historical data for Non-Wildland fires, that CCFD can anticipate an increase in alarm response to between 2-4% annually. This conclusion yields an estimated Non-Wildland alarm response of 88-104 annually for 2011-2015.

Since Wildland fires are very seasonal and temperature dependant predicting the number of alarms is significantly more difficult. However, this proposal will make two assumptions. First, the proposal assumes that there will be, at a minimum, one heavy Wildland fire season from 2011 – 2015. Secondly, the proposal assumes that heavy season will represent, at a minimum, a 50% increase in alarms compared to the other non-heavy fire season years. Utilizing these conclusions it is reasonable to predict an increase in alarms of 5% annually with a minimum of a one time spike of 50%, yielding an average of 107 Wildland alarms with a one time spike to 153 Wildland alarms.

These predictions seems beyond reasonable, especially considering that in 2008 CCFD responded to 166 Wildland alarms and CCFD has already responded to 32 alarms before the end of the first quarter of 2011.



2.3 CCFD Current Equipment



CCFD currently has two front line booster trucks for Wildland fire response, Booster 2 (4403) and Booster 3 (4407). Booster 2 currently has no Wildland PPE and Booster 3 has two sets of out of service coverall style Wildland PPE. Additionally there are 4 more sets of coverall style Wildland PPE hanging in the bay at Central station, all 4 sets are all out of service. The current Wildland PPE owned by CCFD is out of service due to large, un-repairable rips and tears.

Most CCFD firefighters are issued Globe GX-7 Structural Firefighting gear or are slated to have new gear ordered for them as soon as the budget allows. As a frame of reference NFPA 1971 is titled Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting.

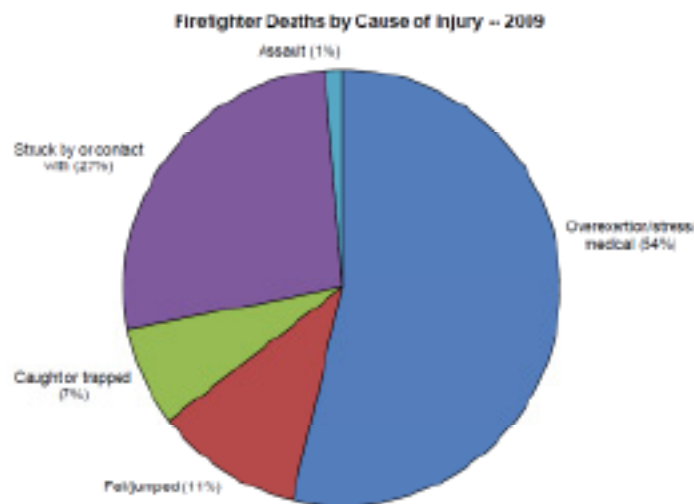
Globe describes the GX-7 as a “structural fire fighting garment” that “meets the garment requirements of NFPA 1971, 2007 Edition.” They further state that the GX-7 is a “protective garment for structural fire fighting in accordance with NFPA 1971-2007” and again list that the GX-7 is to be used “for compliance with the structural fire fighting garment requirements of NFPA 1971.”

Currently CCFD firefighters are forced to use their Globe GX-7, structural PPE, for Wildland fires. Additionally CCFD firefighters must use their structural firefighting gloves, Nomex hood and helmets on Wildland fires.

2.4 Negative Effect of Current Equipment

CCFD's current plan for providing PPE to firefighters for Wildland fires unsafe, expensive, and puts firefighters in a position of unnecessary risk. CCFD however is not in a unique position. The issue of not providing firefighters with the proper PPE for Wildland fires have plagued numerous departments across the United States for decades and the issues appear unilateral.

Before reviewing the negative effect of using structural firefighting PPE on Wildland fire ground operations, it is important to quickly review firefighter line of duty death (herein called “LODD”) statistics. According to the US Fire Administration heat stress is the #1 killer of firefighters, period. That information is backed up by the NFPA. They reported that in 2009 54% of LODD's were related to “Overexertion/Stress/Medical” this is compared to just 7% that died secondary to being “Caught/Trapped”.



Adding the high likelihood for a firefighter to be killed from “Overexertion/Stress/Medical” issues with the intense and numerous Wildland fires that CCFD has faced and will face in the future with the extremely high temperatures that CCFD operates in, it is the opinion of the proposal that Wildland fires represent and clearly defined additional risk factor that must be utilized when making decisions relating to the equipment CCFD firefighters use.

Utilizing structural firefighting PPE for Wildland fires creates the following six general issues.

6. Firefighters are put at even greater risk of physiological stresses, heat stroke, heat exhaustion, and other fatigue related injuries on the fire ground.
7. Firefighters are put at even greater risk of physical injuries due to lack of dexterity, balance, grip, and stability on the often treacherous topography of the Wildland fire ground.
8. Municipalities are spending and wasting tax payer money replacing expensive structural firefighting PPE that is torn, ripped, cut, or otherwise damaged by the rough, sharp, and unforgiving terrain of Wildland fire grounds when compared to the significant cost savings of Wildland specific PPE.
9. Municipalities are at increased civil liability by failing to provide industry standard Wildland specific PPE in the event of firefighter injury or death.
10. Municipalities are at increased internal liability as using structural firefighter PPE for any other purpose that they were designed voids the manufacturer warranty, again wasting tax payer money with unnecessary and overpriced repair and replacement costs.

The proposal will now review each issue in detail.

2.4.1 Firefighters are put at even greater risk of physiological stresses, heat stroke, heat exhaustion, and other fatigue related injuries on the fire ground.

It is common knowledge that heat can injure or kill firefighters. In fact CCFD provides structural firefighting PPE specifically to protect firefighters against injury and death from heat in fires. However it is important to consider some scientific difference between an interior structural firefighting attack and a Wildland firefighting attack. According to the National Wildlife Coordinating Group PPE used by structural fire services is designed to perform differently than that used by Wildland firefighters. Structural firefighting PPE is designed to provide protection to the wearer from high levels of radiant heat, moisture (steam) burns, and direct contact with flames and super heated gasses. This type of PPE is designed for high heat for short periods of time, usually less than 20 minutes as any amount of time longer than that usually dictates a defensive fire attack. However increased protection against radiant heat has been found to increase the probability of structural firefighters of receiving heat stress injuries when the firefighters are physically active for longer periods of time.

Wildland firefighters are often dispatched for hours, especially with larger "mutual-aid" or "strike-team" deployments. Wildland firefighting is physically demanding and requires the balancing of thermal protection from radiant heat with the need to release heat from the body, especially considering the significantly longer deployment times for Wildland firefighting. A key ingredient in controlling physiological stress is controlling body temperature. The human body absorbs heat from the environment (ambient temperature) and produces heat through physical activity. The greater activity, the greater amount of heat generated and therefore the greater amount of physiological stress on the body. The main avenue the body has to release heat is through sweating which carries heat away from the body in a vapor form. In managing a firefighter's physiological stress it is important that this vaporized heat be evaporated as soon as possible. According to the US Forestry Service, PPE is a "key factor in reducing heat stress" and noting that two thirds of the firefighters heat load is generated internally, with only one third coming from the radiant heat of the fire. The Forestry Service concluded that the design of Wildland PPE be such that it "let heat out, not keep heat out."

2.4.2 Firefighters are put at even greater risk of physical injuries due to lack of dexterity, balance, grip, and stability on the often treacherous topography of the Wildland fire ground.

The Texas Forestry Service in their Wildland Urban Interface Operations class warns of the use of structural PPE on the Wildland fire ground as it is designed to protect against nails and other sharp ground hazards associated with interior structural firefighting and reduces grip in the Wildland fire ground. Further structural firefighting gloves are designed to provide intense thermal protection at the sacrifice of dexterity. Wildland firefighting requires greater dexterity to utilize hand tools especially when considering the longer periods of time firefighters are deployed. The additional weight of structural firefighting PPE when compared to Wildland gear can cause firefighters to trip, fall, and otherwise lose stability when working on the Wildland fire ground leading to greater risk of physical injury.

2.4.3 Municipalities are spending and wasting tax payer money replacing expensive structural firefighting PPE that is torn, ripped, cut, or otherwise damaged by the rough, sharp, and unforgiving terrain of Wildland fire grounds when compared to the significant cost savings of Wildland specific PPE.

The City of Coppecos Cove currently spends \$1150 for a structural firefighting Globe GX-7 coat and pants set. A set of Wildland gear averages just \$400.

According to Globe the average serviceable life for structural firefighter PPE, such as the GX-7, is 3 years. Globe defines a unit's serviceable life as the "the period of time protective clothing, which has been properly cared for, can be expected to provide reasonable limited protection." They further state that an owner can extend the serviceable life of structural firefighter PPE "dependent upon the amount and severity of field use and exposure the equipment has experienced."

Not counting for savings from a decrease in repairs to structural firefighting PPE worn during Wildland firefighting operations; if we follow the Globe average structural firefighting PPE serviceable life of 3 years with full wear and the investment in Wildland PPE increases that life from 3 years to 4 years, the operational cost savings per year, per unit will be \$29.16 or \$116.64 per serviceable life of a set of structural firefighting PPE. Over the 41 current front line operations member's savings would be \$4782.24 every 4 years. If we increased the serviceable life from 3 to 5 years CCFD's total savings could increase to \$17,765.30 every 5 years. These estimates will be discussed further in section 4.1.

2.4.4 Municipalities are at increased civil liability by failing to provide industry standard Wildland specific PPE in the event of firefighter injury or death.

In this the age of litigation, municipalities must be ever vigilant to make every effort possible to protect themselves from any possible civil liability, actual or simply perceived. NFPA 1500 covers the Fire Department Occupational Safety and Health Program, where it states that "the fire department shall provide each member with the appropriate protective clothing and protective equipment to provide protection from the hazards to which the member is likely to be exposed. Such protective clothing and protective equipment shall be suitable for the tasks that the member is expected to perform." It continues to state "the fire department shall establish standard operating procedures for the use of Wildland protective clothing and equipment and that fire department members who engage in or are exposed to the hazards of Wildland firefighting shall be provided with and use a protective ensemble that meets the requirements of NFPA 1977." And while NFPA 1500 has not been adopted by the TCFP as law in the State of Texas, it's words could provide an opportunity to an avid trial lawyer to at

the very least inconvenience the City Attorney's office with a frivolous law suit and the expense of it's defense or at worst truly place the city in a position of liability.

2.4.5 Municipalities are at increased internal liability as using structural firefighter PPE for any other purpose that they were designed and the manufactures warranty, again wasting tax payer money with unnecessary and overpriced repair and replacement costs.

Globe provides a limited warranty for the GX-7 structural firefighter PPE garments. According to the warranty page at <http://globetextonoutgear.com/globe/technical-data/warranty> "this warranty shall not be effective unless the products are used for the purpose for which they were designed." As previous stated in section 2.3 "Globe describes the GX-7 as a "structural fire fighting garment" that "meets the garment requirements of NFPA 1971, 2007 Edition." They further state that the GX-7 is a "protective garment for structural fire fighting in accordance with NFPA 1971-2007" and again list that the GX-7 is to be used "for compliance with the structural fire fighting garment requirements of NFPA 1971." Therefore using the GX-7 for any purpose other than "structural firefighting" would nullify the warranty, making it ineffective. The Globe warranty page on their website continues to state that "Failure to properly care for the garment will lead to a shortening of the serviceable life."

It seems apparent that the CCFD using their structural firefighting PPE for purposes other than structural firefighting exposes the City of Coppertown Cove to addition, unnecessary liability, by voiding the warranty on brand new PPE.

3. Proposal

3.1 Summary of Standards

At this time the TCFP has only adopted the following NFPA Codes and Standards as law:

- ◆ 1971 - Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
- ◆ 1851 - Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
- ◆ 1981 - Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services
- ◆ 1852 - Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)
- ◆ 1982 - Standard on Personal Alert Safety Systems (PASS)
- ◆ 1989 - Standard on Breathing Air Quality for Emergency Services Respiratory Protection
- ◆ 1561 - Standard on Emergency Services Incident Management System

This means that currently there is no legally required standard in the State of Texas regarding Wildland firefighting PPE.

Yet as stated in 2.4.4 NFPA 1500, Fire Department Occupational Safety and Health Program, does mandate that "appropriate" PPE be provided for Wildland fires and that such PPE meet or exceed NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting."

The NFPA 1977 standard is quite specific on the labeling, testing, size, and thermal protective minimums for Wildland PPE. It breaks down everything from the length of the sleeves to the amount of reflective markings that must and/or can be shown. Specific to PPE NFPA 1977 sets standards for Helmets, Neck/Face Protection, Jackets or Long Sleeve Shirts, Pants or Coveralls, Gloves, Boots, and Eye Protection/Goggles.

Since there is no legally required standard for Wildland PPE in Texas the decision to provide protection and what level of protection is left up to the individual department.

3.2 Plan of Action

As the TCFP does not set forth a specific standard requiring the purchase of Wildland PPE, it is the opinion of the proposal that the CCFD should make it a priority to provide the firefighters of the CCFD with the best most economical Wildland PPE that will tackle the greatest risks to our operations personnel. As this proposal has pointed out the greatest danger to firefighters during Wildland firefighting operations is not the heat of the fire or the rough terrain, but the heat stress the firefighters own body must remove to avoid heat stroke, cardiac arrest, and rapid dehydration. To that end the proposal suggests that CCFD make it a priority to first invest in Wildland Jackets and then implement a plan to then add Wildland Gloves within 18 months.

The proposal further suggests that due to current funding constraints that the CCFD sets forth the following as a Wildland PPE minimum,

- ◆ Currently worn duty boots (leather)
- ◆ New Wildland Pants, individually assigned
- ◆ New Wildland Jacket, individually assigned
- ◆ Personally provided black belt (at option of firefighter)
- ◆ Currently owned "modern style" helmets with face shield, two assigned to each brush truck
- ◆ Either currently provided structural gloves or personally provided leather gloves (at option of firefighter)

This new Wildland ensemble will address the greatest risks the CCFD firefighters currently face on Wildland fires while still attempting to be budget constraint friendly. The use of currently provided duty boots keeps costs down provides firefighters with better traction with a lower weight than the currently used structural fire boots.

The new Wildland pants and jacket will be explained in the next section in detail. The proposal is suggesting the separate pant/jacket instead of the coverall style to attempt to provide a wider range of sizes to the diverse CCFD firefighter crews while still addressing cost concerns. This separate system will allow us to purchase different lengths and widths of pants with different lengths and sleeves of jackets without being limited to each others length or width. Even though the proposal is asking for an initial investment in individually assigned Wildland PPE, which would be individually sized, the proposal also considers what will happen with normal attrition and turnover within the department. The separate jacket and pants selection give the CCFD increased options in sizing personnel with different sized upper and lower bodies together with different sized jackets and pants, further this option saves on repair and replacement costs as the CCFD will only need to purchase or repair the specific part that is damaged rather than the entire garment. The research of the proposal suggests too

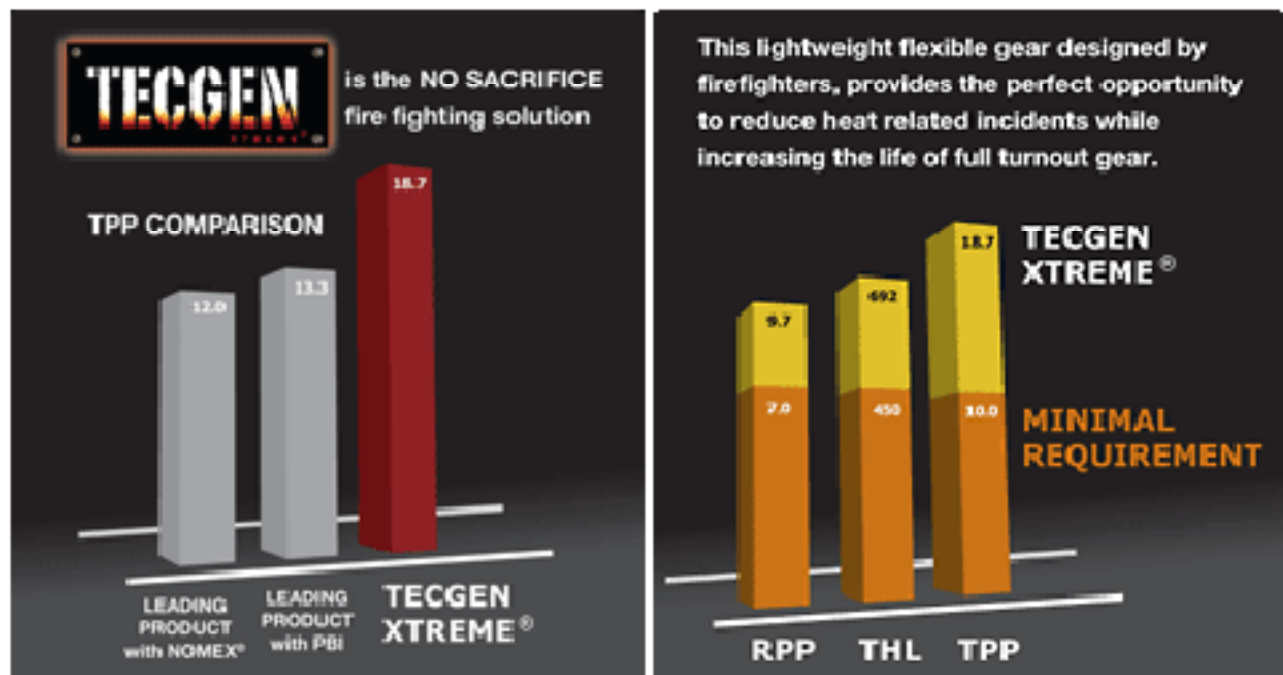
that there is little to no cost savings or incursion by selecting separate pants and jackets from a coverall style garment.

The specific Wildland pants proposed in section 3.3 have an adjustable waist strap. This allows up to 3" of adjustment on any particular waist, however, sometimes it some firefighters may find that adding a belt to the pants will make wearing them for longer periods of time more comfortable, adding the option to the firefighter of adding a belt simple makes the PPE more diverse.

The proposal asks that we assign two currently owned "modern style" helmets to each brush truck. These helmets are much lighter than the traditional helmet worn by many CCFD firefighters and assigned them to each truck will make the process of "switching trucks" less strenuous on firefighters by reducing the number of the items necessary to transfer. Additionally, due to current cost constraints the proposal seeks to utilize our currently owned leather structural firefighter gloves until "Wildland" specific leather gloves can be integrated over the next 18 months. As the future investment in Wildland specific gloves is not going to be in this budget year, the proposal presumes that CCFD Administration can incorporate this in to their next fiscal years initial budget proposal.

3.3 Teegen Xtreme

The proposal has researched numerous Wildland PPE vendors and presents Teegen Xtreme as the forefront of Wildland PPE. The Teegen fabric is a brand new fiber that exceeds every standard for thermal protection while offering the wearer a cooler and more comfortable interior that allow heat to naturally dissipate. This results in a better protected firefighter, who can operate for longer periods of time, with less fatigue, and a greater resistance to heat stresses.



The gear the proposal is suggested is UL certified to exceed every standard of NFPA 1977 and further provides a multi-mission role fulfillment for future CCFD responses such as Technical Rescue (exceeding NFPA 1951), Vehicle Extrications, and any other non-structural response.

The implementation of Tegen Xtreme PPE will resolve all 5 of the negative effects of our current use of structural PPE for non-structural firefighting. Investing in Wildland specific Tegen Xtreme PPE will:

1. Firefighter risk of injury from heat stresses and physiological stresses such as heat stroke, heat exhaustion, and other fatigue related injuries on the fire ground will be reduced due to the Tegen Xtreme's ability to let the heat that the firefighter internally produces out, while simultaneously providing better external thermal protection.
2. Firefighters will have reduced physical injuries from lack of dexterity, balance, grip, and stability on the often treacherous topography of the Wildland fire ground as the Tegen Xtreme gear is lighter, easier to maneuver in, and provides the wearer with less weight to have to carry on steep hills.
3. The City of Copperas will be able to save money by repairing or replacing significantly (65% less) less expensive Wildland PPE that is torn, ripped, cut, or otherwise damaged by the rough, sharp, and unforgiving terrain of Wildland fire grounds.
4. Implementing Tegen Xtreme Wildland PPE will help provide a circumferential defense against civil liability by failing to provide industry standard Wildland specific PPE in the event of firefighter injury or death.
5. Implementing Tegen Xtreme Wildland PPE will prevent the voiding of the manufacturer's warranty, saving wasting tax payer money.

Tegen Xtreme is a revolutionary new fabric that presents the CCFD with the best product for the job. Furthermore Tegen Xtreme is equally priced when compared to equal and lesser equipment. Tegen Xtreme Jackets list for \$249 and the Pants list for \$219. There are numerous local vendors who CCFD can contact to received bids which would lead to a lower final cost. For the purposes of this proposal the estimated savings is \$68 per set, with a final cost of \$400 per set. This cost is designed to include fitting each operations member with custom sized gear. There are other options for purchasing Wildland PPE but this proposal is specifically recommending Tegen Xtreme, as it represents the best quality and best protection available.

Lesser Wildland PPE ensembles are sold by numerous other companies. Crew Boss manufactures a Wildland Interface Jacket and Pants from Nomex, this set lists at \$510 (\$42 more than Tegen) and offers approximately 24% less thermal protection. PGI makes a less expensive Fineline Wildland Jacket and Pants, also from Nomex. This PPE ensemble lists at \$320 and again offers approximately 24% less thermal protection performance.

There are also discount Wildland outfitters who offer combo packages that include a bag, jacket, pants, helmet, goggles, and gloves. While these combos may seem to be a good "price" research has shown them to lack value and more importantly protective ability to the firefighters who must wear them. One web-outlet offers this combo for "just" \$419. But a closer review shows that the pants and jackets they include are un-branded and have a 25% less dense fabric protecting the firefighters from proximal heat injuries.

It is the opinion of the proposal that small savings in cost should not be at the expense of thermal protection or the denseness and quality of the fabric. Additionally the purchase of bare minimum standards should never been an acceptable safety practice when protecting the health and safety of firefighters.

3. Conclusion

3.1 *Summary and ROI*

The citizens of Copperas Cove entrust their lives and the protection of property to the Copperas Cove Firefighters. With the high risk for Wildland fires within the response of the CCFD it is the opinion of the proposal that providing the right Personal Protective Equipment is imperative to ensuring the life safety of the firefighters who are sworn to protect the city. Further Wildland fires are not a rare occurrence for the CCFD; they're a part of an often daily response. The current Wildland PPE provided by the department is unacceptable, unsafe, and out of service. The "Plan B" strategy of using Structural firefighting PPE in the Wildland firefighting interface is dangerous, unsafe, and places extreme financial liabilities on the city.

Now is the right time to address this issue, not tomorrow. With Wildland fire season right around the corner and with this years Wildland fire statistics showings a busy season brewing let's take the proactive steps now to provide those who protect the city with the best equipment to protect them.

This investment isn't just an expense, it's a capitalized savings of up to \$17,765 in just five years. This figure is accounted assuming that the current serviceable life of the structural firefighting gear worn on Wildfires is now 3 years and that implementing Teegen Xtreme Wildland specific PPE would extend the serviceable life to 5 years. If we could manage to extend even half of the operations gear to 6 years we could see a further increase in capitalized savings to \$30,748.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Cost of Structural PPE per year in service	Average "Serviceable Life per Manufacturer"			Extended "Serviceable Life"		
	\$383.33			\$287.50	\$230.00	\$191.67
Savings Per Unit by Extended "Serviceable Life"				\$95.83	\$153.33	\$191.66
Cost per year of Teegen Xtreme Wildland PPE with 5 year Serviceable Life				\$66.67	\$66.67	\$66.67
Annual Savings per Unit by Extending "Serviceable Life"				\$116.64	\$433.30	\$749.96
Total Annual Savings of Operations Department (41 members)				\$4782.24	\$17765.3	\$30748.36

Further all of these estimates do not include the direct savings the CCFD would see from a decrease in structural firefighting gear repairs from tears, cuts, or rips from wearing the wrong gear on the wrong fireground.

And none of these "estimates" include accounting for the priceless value of a firefighter's health and life. Implementing the Teegen Xtreme Wildland specific PPE will make the firefighters of the City of Copperas Cove safer. It will reduce heat related injuries and physical injuries that are associated with wearing the wrong gear on the wrong fire.

The proposal hopes that all of you will take immediate action to provide the firefighters of Copperas Cove with the right equipment for the fires they respond to meet...before this very busy fire season begins and causes unnecessary injury or a terrible loss of life.

5.2 References

- 2.1 CCFD alarm statistics obtained from Firehouse software database
- 2.1 Historical Drought Data obtained from <http://www.ncdc.noaa.gov/sats/fire/2008/11>
- 2.2 Current Drought Data obtained from <http://www.ncdc.noaa.gov/sats/fire/>
- 2.4 Historical issues with other fire departments and Wildland PPE from <http://www.usfa.dhs.gov/pdf/efop/efo29732.pdf>
- 2.4 2009 NFPA Study on firefighter LODD <http://www.nfpa.org/assets/files/pdf/csiff.pdf>
- 2.4.1 Thermal Protective Performance Data <http://www.ppe101.com/data/TTP-Guidance.doc>
- 2.4.1 US Forestry Service <http://www.blackhull-wildfire.com/Pubs/InjuriesIllnessesFatalitiesFirefighters.pdf>
- 2.4.2 Texas Forestry Service, Wildland Urban Interface Introduction/Operations Training
- 3.1 Summary of NFPA 1977 specs for Wildland gear
http://www.becomeadown.com/efinfo/techfacts/techpdf/wildland_firefighting_334.pdf
- 3.3 Pricing for Terigen Xtreme
http://www.thefirststore.com/store/category.cfm/cid_1058_pgi_wildland_gear/
- 3.3 Pricing for Crew Boss Wildland PPE
http://www.thefirststore.com/store/category.cfm/cid_348977_crew_boss_turnout_gear/
- 3.3 Pricing for PGI Wildland PPE
http://www.thefirststore.com/store/category.cfm/cid_1058_pgi_wildland_gear/
- 3.3 Pricing for Unbranded Wildland PPE Combo
http://www.wildlandwarehouse.com/wwwcatalog/VED_Wildland_Firefighting_Clot_P3241C367.cfm?UserID=19709485&jsessionid=2430a5ca8e6b0502ef8e53405a466e182884

RESOURCES

- Responder Help by the VFIS offers a Searchable SOG Database filled with examples:
<https://www.responderhelp.com/sog-finder/>
- Fire-Dex's WE CARE page is dedicated to educating firefighters and providing helpful tips and resources:
<https://www.firedex.com/wecare/>