AN EVALUATION OF THE NEED FOR PROXIMITY PROTECTIVE CLOTHING FOR AIRCRAFT FIREFIGHTING

STRATEGIC MANAGEMENT OF CHANGE

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An applied research project submitted to the National Fire Academy
as part of the Executive Fire Officer Program

December 1999

ABSTRACT

The Occupational Safety and Health Administration (OSHA) has specified that all airport fire departments must provide proximity protective clothing to their firefighters. The purpose of this paper was to identify the need for the application of risk management in determining what protective clothing is appropriate.

The methodology used to look at these requirements involved a literature review of the pertinent materials contained in the National Fire Academy's Learning Resource Center, documents contained in the Royal Air Force Mildenhall Fire Department reference library, and information located on the Internet in an evaluative research effort to answer the following questions:

1. What are the protective clothing requirements for airport firefighter protection?
2. Is there a risk management tool available for the fire chief's use?
3. What types of protective clothing are available?
4. What standards address firefighter safety and health?

The results revealed there is no data to indicate firefighters have been injured in aircraft firefighting operations while wearing structural protective clothing. Data does show that injuries do occur for non-airport fire departments because of radiant heat, but there is no OSHA mandate for specific gear to be worn as in aircraft firefighting. Ample risk management resources are available to the fire chief to evaluate protective clothing needs for airport firefighters, but they can't be used because of OSHA's ruling. The recommendation provided was that fire chiefs challenge the proximity gear ruling and that the Department of Defense specifically readdress OSHA's interpretation.

TABLE OF CONTENTS

INTRODUCTION

Firefighting is a dangerous profession. Fires involving tremendous amounts of flammable liquids, producing large amounts of radiant heat, subject firefighters to severe conditions that can cause injury in a short period of time. The type of Personal Protective Equipment that should, or can, be worn in firefighting operations involving high levels of radiant heat is a subject that continues to be debated among members of the fire service. Aircraft firefighting operations are at the center of this debate, as is evidenced by the Occupational Safety and Health Administration (OSHA) decision that airport firefighters must wear proximity firefighting protective clothing.

The problem is OSHA doesn't allow risk management to be used to determine the appropriate level of protective clothing for airport firefighters. The purpose of this paper was to identify the need for the application of risk management in determining what protective clothing is appropriate.

A literature review of the pertinent materials contained in the National Fire Academy Learning Resource Center, documents contained in the Royal Air Force Mildenhall Fire Department reference library, and information located on the Internet were used in an evaluative research effort to answer the following questions:

1. What are the protective clothing requirements for airport firefighter protection?
2. Is there a risk management tool available for the fire chief's use?
3. What types of protective clothing are available?
4. What standards address firefighter safety and health?

BACKGROUND AND SIGNIFICANCE

Since the Department of Defense (DoD) and the United States Air Force (USAF) directed the adoption of all National Fire Protection Association (NFPA) standards in 1991, one of the primary NFPA standards to impact all fire departments was NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*. This standard became the foundation for all fire department operations and safety programs.

Public Law 104-113, section 12 (d), codifies Office of Management and Budget Circular A-119 requiring federal agencies to adopt and use standards developed by voluntary consensus standards bodies and to work closely with those organizations to ensure that the developed standards are consistent with agency needs (The National Technology Transfer and Advancement Act of 1995, 1996). In a proactive move to improve protection for USAF people and resources, Air Force Policy Directive 32-20: *Fire Protection* (USAF, 1994), was written to guide fire protection policy within the USAF, prior to the enactment of The National Technology Transfer and Advancement Act of 1995. This directive says, “The Air Force will ensure its fire protection operations comply with all applicable national, state, local, and Department of Defense (DoD) regulations, as well as National Fire Codes published by the National Fire Protection Association (NFPA)” (USAF, 1994, p. 1).

In the United States Air Forces Europe (USAFE), there are 12 USAF installations that provide a variety of mission activities. Five of these installations are Main Operating Bases (MOBs) with large flying missions, while the remaining seven are considered support installations. The support installations receive support and direction from the MOBs in all functional areas. All of these installations support structural

firefighting missions, but the MOBs also support fighter and cargo aircraft missions, which include munitions storage and transportation. Large quantities of jet fuel are transported, on-loaded and off-loaded aircraft, and transferred to and from storage tanks via pipelines at the MOBs. As a result, the potential for large radiant heat fires from flammable liquids is great.

The 1997 revision of NFPA 1500 identified the requirement for airport firefighters to wear proximity protective clothing for all aircraft firefighting operations, but there was little rationale provided to explain the change in requirements. At that time, all of the fire departments in USAFE were wearing structural protective clothing for all firefighting operations, including aircraft firefighting, and had suffered no injuries resulting from the wear of structural gear. Two significant aircraft crashes occurred in the 1990's in USAFE, one involving a C-5 cargo aircraft and one involving an F-15 fighter aircraft. Firefighters fought the fires "close-in" without any burn injuries, all the while wearing structural gear. NFPA 1500 (NFPA, 1997b) initiated a lot of discussion and confusion over the standard, and many fire chiefs resisted changing to proximity gear because structural gear met their Personal Protective Equipment (PPE) requirements. Another reason for the resistance was cost. "Proximity gear, up to 30% more expensive than structural gear, would require constant maintenance and replacement to deal with the rigors of continuous training, let alone actual firefighting" (Riecher, 1999, p. 22). Further fueling the debate, John Plummer (1997), Occupational Safety and Health Administration (OSHA) Director of Federal Agency Programs, issued an interpretation that said, "In 1992, the NFPA promulgated NFPA 1976…which requires aluminized proximity protective clothing for aircraft firefighting" (p. 1). He went on to say, "…an

employer may be cited for failure to follow NFPA 1976" (p. 1). However, Bruce Teele, Senior Fire Service Safety Specialist with the NFPA, explained that "…1976 is a product standard…" for proximity gear (Riecher, 1999, p. 12). NFPA 1500 (NFPA, 1997b) is actually the "requiring" standard for proximity gear, but this inaccuracy by Plummer further confused the situation. Unfortunately, nowhere did OSHA address risk management as a tool for the fire chief to use in determining what type of protective clothing was required, even though NFPA 1500 (NFPA, 1997b) specifically requires risk management to be applied to protective clothing. Today, the matter of what type of clothing to wear is still being debated.

Because of the direction given by NFPA 1500 (NFPA, 1997b), and the intent of the interpretation provided by Plummer (1997), USAF fire chiefs changed their department protective clothing standards and started using proximity gear. The Royal Air Force (RAF) Mildenhall Fire Department spent $140,000 in September 1997 to buy enough proximity gear to outfit each member of the department, though the structural gear in use was still serviceable and provided adequate protection for the firefighters. Since that time, $89,000 was spent in proximity gear to continue providing the required level of protection to firefighters. Though figures aren't available for previous years, personal recollections confirm that this is a much higher annual cost than was experienced when firefighters wore structural gear.

Though the requirement for proximity gear is clear if you refer to NFPA 1500 (NFPA, 1997b), that clarity is blurred by other NFPA standards and statements made by people that are senior members of the fire service. Stephen Foley, NFPA Senior Fire Service Specialist, said, "If you talk to a majority of airport fire departments, they don't carry

proximity protective clothing anymore. They carry structural firefighting protective clothing because the Federal Aviation Administration considers the fuselage of an airplane to be a structure" (Riecher, 1999, p. 13). This leaves many fire departments in a quandary as to what type of gear they should be wearing, and as a result you will find a mixture of both proximity gear and structural gear being worn by airport firefighters across the country (W. A. Moore, personal communication, September 22, 1999).

The *Strategic Management of Change* course offered as part of the National Fire Academy Executive Fire Officer Program provided guidance for this applied research paper. The problem addressed by this research project related specifically to Phase I: Analysis. This phase of the model was designed to explore the responsibilities of, and options available to, the fire chief in providing for the safety of the members of the department.

LITERATURE REVIEW

The literature review involved resources obtained from the National Fire Academy Learning Resource Center, NFPA standards, National Institute of Standards and Technology, recurring periodicals such as *Industrial Fire World*, *Fire Engineering, Fire Chief* and *NFPA Journal,* and DoD Instructions, Manuals and Standards, some of which were found on the Internet.

To ensure a common understanding of terminology, some definitions are needed that will clarify the material contained in this document. NFPA 1500 (NFPA, 1997b) was used as the primary document in defining the following terms;

Proximity Fire Fighting. Specialized fire-fighting operations that can include the activities of rescue, fire suppression, and property conservation at incidents involving

fires producing very high levels of conductive, convective, and radiant heat such as aircraft fires, bulk flammable gas fires, and bulk flammable liquid fires. Specialized thermal protection from exposure to high levels of radiant heat, as well as thermal protection from conductive and convective heat, is necessary for persons involved in such operations due to the scope of these operations and the close distance to the fire at which these operations are conducted, although direct entry into flame is not made. These operations usually are exterior operations but might be combined with interior operations. Proximity fire fighting is not structural firefighting but might be combined with structural firefighting operations.

Structural Firefighting. The activities of rescue, fire suppression, and property conservation in buildings, enclosed structures, aircraft interiors, vehicles, vessels, or like properties that are involved in a fire or emergency situation.

Risk Management. Identification and analysis of exposure to hazards, selection of appropriate risk management techniques to handle exposures, implementation of chosen techniques, and monitoring of results, with respect to the health and safety of members.

Authority Having Jurisdiction. The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

The American Heritage Dictionary of the English Language, Third Edition (1996), defines radiant heat as “Consisting of or emitted as radiation.”

Air Force Instruction 32-2001: *Fire Protection and Fire Prevention Program* (USAF, 1999), describes the Authority Having Jurisdiction (AHJ) according to the type of situation being confronted;

For permanent deviations to NFPA standards, the Air Force Civil Engineer is the appropriate level of approval.

For long-term deviations (more than 18-months), the major command civil engineer is the approval authority.

For short-term deviations (less than 18-months), the installation commander is the AHJ.

NFPA 1500 (NFPA, 1997b) is clear in the requirement that:

> Members who engage in or are exposed to the hazards of proximity fire fighting shall be provided with and shall use both proximity protective coats and proximity protective trousers...The proximity protective coat…and trousers…shall meet the applicable requirements of NFPA 1976, Standard on Protective Clothing for Proximity Fire Fighting (section 5-4.1).

It goes on further to state that members will be provided with helmets, gloves, footwear, and hoods that meet the requirements of NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting*, with additional radiant reflective criteria that is approved for the expected proximity fire fighting exposure (NFPA, 1997b).

NFPA 1500 (NFPA, 1997b) is also clear when it comes to risk management requirements for the safe operation of the fire department:

> The fire department shall develop and adopt a comprehensive written risk management plan. The risk management plan shall consider all fire department policies and procedures…The risk management plan shall at least cover the risks associated with the following:…(e) Protective clothing and equipment, (f) Operations at emergency incidents… (section 2-2).

The components of a risk management plan include risk identification, risk evaluation, risk control and risk management monitoring (NFPA, 1997b). This requirement for implementing a risk management program is designed to give the fire chief some latitude in determining what type of protective clothing would best suit fire fighters. This is supported by Riecher (1999) when he says, "…the responsibility for choosing the right PPE should rest with the person best suited to evaluate the risks at the fire scene and take the appropriate action to protect life and property--the incident commander" (p. 24).

According to Randy Lawson, National Institute of Standards and Technology, (personal communication, August 10, 1999),:

> Injury statistics on the use of various types of Personal Protective Equipment (PPE) are not available. Regrettably, people responsible for keeping statistics on firefighter injuries don't breakdown injury data according to the use of PPE. This type of data would be very helpful.

Firefighters and the NFPA confirm there is a lack of information. Division Chief Kirk Owen (1996), Plano Fire Department, points out that, "Unfortunately, thorough investigations are not usually conducted on burn injury incidents. Thus, it is difficult to determine the factors that contributed to the injury" (p. 9). According to Nancy Schwartz from the NFPA (personal communication, July 2, 1999), "Our statistics on firefighter injury cover nature of injury and type of duty, but the database is not specific..." Rita Fahy, another NFPA staff member (personal communication, August 23, 1999), recalls that she, "…can't think of any firefighter deaths in the last 20 years during aircraft firefighting."

Identifying injuries isn't as simple as it sounds. Owen (1996) explained:

> "Firefighter burn injuries are, to say the least, a very complicated issue. Many factors can contribute to an injury. These include incident management, risk management, tactics, equipment, training, and discipline. Although we often look to the protective clothing for answers when a firefighter is burned, the clothing may or may not have contributed to the injury. It is possible that the protective clothing provided the level of protection for which it was designed. The thermal conditions may, however, have exceeded the limitations of the garments" (p. 9).

Karter and LeBlanc (1998) reported that in 1997, 14.7% of the injuries sustained were a result of exposure to fire products. Washburn, LeBlanc and Fahy (1999) found that in 1998, five firefighters died from burns, but none of the injuries were received during aircraft firefighting.

The International Fire Service Training Association teaches firefighters that "Proximity suits are designed for close proximity exposures to flame (not direct flame contact) and radiant heat temperatures as great as 932 degrees F (500 degrees C) for five minutes or more" (International Fire Service Training Association [IFSTA], 1995, pp. 29-30).

Larry Williams (1989), an aircraft firefighting training consultant, acknowledges that new firefighting technologies make firefighting somewhat safer:

> The technology of crash fire rescue firefighting has advanced well beyond the days of chemical foam and asbestos suits to the point where 6,000-gallon capacity crash vehicles can be operated by one person. Nearly all the actual firefighting occurs

> from inside the vehicle…Now with advanced (albeit leaky) hydraulics, we can deliver adequate quantities of foam from greater distances than ever before (p. 56).

The Federal Aviation Administration (1995) takes the same view when it comes to firefighting operations:

> While at least one proximity ensemble per response vehicle is customary, the selection, purchase and use of proximity or non-reflective protective clothing is a decision made by airport management based on operational considerations and risk assessment. Advanced primary firefighting agents, such as AFFF, now enable airport firefighters to control and essentially extinguish large aviation fuel fires while still in the attacking vehicle. This means that aviation fuel fires can be controlled in minutes before leaving the vehicle and advancing handlines. Therefore, firefighters often do not need to leave the vehicle before the levels of radiant heat are low enough to allow the use of non-reflective gear… (p. 4).

But, Williams (1989) cautions, "The concern with protective clothing focuses on secondary extinguishment and rescue" (p. 56). He goes on to say that:

> Structural gear does not perform particularly well against radiant heat. Steam burns are a constant hazard when such clothing is worn at aircraft fires. The radiant heat penetrates the suit and the moisture from the body inside the suit turns to steam, causing second- and third-degree burns… (p. 56).

Lawson (1996) agrees; "Once sweating has begun, firefighters become susceptible to injuries referred to as steam or scald burns" (p. 7). The trapped moisture inside the suit may cause a decrease in thermal protective performance of the suit, especially

where the fabric is compressed (Lawson, 1996). Williams (1989) does concede though that structural gear does make rescue easier from aircraft.

Foley explains an important factor regarding the wear of proximity gear when he says, “If you talk to a majority of airport fire departments, they don’t carry proximity protective clothing anymore. They carry structural firefighting protective clothing because the Federal Aviation Administration considers the fuselage of an airplane to be a structure” (Riecher, 1999, p. 13). Foley goes on to say that should the fuel tanks rupture on an aircraft, structural gear is not going to provide the necessary level of protection (Riecher, 1999). Proximity gear on the other hand will, according to Williams (1989). “The modern proximity suit provides for up to 90 percent reflection of radiant heat” (Williams, 1989, p. 56).

The need for wear of proximity gear continues to be questioned because of statements such as “…where aircraft crash and rescue is less than 5 percent of the tasking, then proximity firefighting is ‘incidental’ and not the primary job” (Riecher, 1999, p. 12). There is no “science” to quantify this statement, yet it relieves a department from the need to wear proximity gear if less than 5% of their operations involve aircraft crash and rescue. Master Sergeant Brad Nicholson (personal communication, August 10, 999), Headquarters USAFE Fire Protection Office, reported that from January 1996 to August 1999 there were 75 aircraft fires and 1,050 structural fires. That translates to 7% of the fires in USAFE involving aircraft. At RAF Mildenhall, the fire department responded to 1256 emergencies in fiscal year 1998 and 1999, of which 222 were emergency responses and 5 were fires. That equates to 2% of the emergency responses being aircraft “fires.” Based on that calculation, proximity firefighting should

be considered “incidental” and proximity gear would not be required. However, it is possible to deduct from the data provided that actually 17% of the “responses” at RAF Mildenhall were aircraft crash and rescue responses and proximity gear is therefore required. The difference is between “responses” and “fires” and which applies to the determination of “incidental.” Plummer’s (1997) interpretation does not specify which definition to use in determining “incidental.”

NFPA 1976 (NFPA, 1992) says:

> The purpose of this standard is to provide minimum performance requirements for proximity protective clothing worn by firefighters primarily responsible for aircraft rescue and fire fighting, bulk flammable liquids fire fighting, flammable gas fire fighting, and similar situations releasing high levels of radiant heat (section 1-2.1).

This is the standard quoted by Plummer (1997) in his interpretation, saying, “In 1992, the NFPA promulgated NFPA 1976…which requires aluminized proximity protective clothing for aircraft firefighting” (p. 1). He went on to say, “…an employer may be cited for failure to follow NFPA 1976” (p. 1). The actual excerpt from NFPA 1976 and statement by Teele, “…1976 is a product standard…” for proximity gear, show Plummer’s statement to be inaccurate (Riecher, 1999, p. 12). The FAA (1995) doesn’t require proximity gear for aircraft firefighting, not only because they treat the fuselage as a structure, but because “…firefighters often do not need to leave the ARFF vehicle before the levels of radiant heat are low enough to allow the use of nonreflective gear” (section 4). They also say in the same document, “…As with any protective clothing, training and education need to be conducted to educate firefighters concerning proper use, care, and PPE limitations” (FAA, 1995, section 4). Teele (1997) agrees, “…If the

operation is successful in quickly 'knocking down' the fire, then the environment should improve and temperatures decrease" (p. 17). He continues by stressing, "Well managed, highly trained, closely supervised, and properly staffed fire departments are equally essential elements of safety in order to minimize the operational risk" (p. 18). He further identifies the need for risk management when he says, "With any selection of protective equipment, fire departments must carefully review their needs and determine what will be an appropriate level of protection" (p. 19).

PROCEDURES

Methodology

A questionnaire was developed (see Appendix A) and sent to 176 fire departments within the USAF to identify their current levels of protective clothing, some history regarding their clothing, and injuries they may have sustained as a result of wearing "improper" protective clothing.

The literature review was also used. Sources of information from the National Fire Academy Learning Resource Center, recurring periodicals, NFPA standards, and DoD instructions, manuals and standards were used in this effort. The focus of the review was to determine the requirements for wearing proximity gear and the application of risk management in the selection process. The objective was to identify the contradictions facing fire officers and suggest a possible adjustment to the current requirements for airport fire departments.

Additionally, an interview with the Deputy Chief of United States Air Forces Europe Fire Protection was conducted.

First, a review of national level standards was conducted to identify the requirements for proximity gear. Then, an in-depth investigation into various periodicals, interviews, federal government standards, and USAF instructions was undertaken to identify other professional and regulatory opinions and guidance. Next, the questionnaires received from 45 USAF fire departments were reviewed to compare the inputs of the fire chiefs from those departments to get an overall picture of the previous and current levels of protection afforded their firefighters, and the history of their department regarding firefighter injuries.

The final step was to compare and contrast all of the standards and professional opinions to identify possible changes to the OSHA stance on proximity gear for airport firefighters.

Limitations

Results from the questionnaire were limited to the sample of departments that responded to the request, and the flying operations and associated risks found at RAF Mildenhall. Other airports around the world might have more extensive, or less demanding, responsibilities for aircraft firefighting and rescue based on the mission of their facility.

Not all USAF departments responded to the questionnaire, leaving some uncertainty as to how those missing departments meet their PPE requirements, and how many injuries they have experienced as a result of wearing improper PPE.

RESULTS

Answers to Research Questions

1. What are the protective clothing requirements for airport firefighter protection?

The governing standard for the proximity gear requirement for airport fire departments is NFPA 1500. However, FAA Advisory Circular 150/5210-14A (1995), is contradictory and may be causing confusion among civilian airport fire departments. A survey of nine of the United States' largest airport fire departments in 1995 found three departments still wearing structural gear for firefighting and rescue operations (W. A. Moore, personal communication, September 22, 1999)

Public Law 104-113, section 12 (d), codifies Office of Management and Budget Circular A-119 requiring federal agencies to adopt and use standards developed by voluntary consensus standards bodies and to work closely with those organizations to ensure that the developed standards are consistent with agency needs (The National Technology Transfer and Advancement Act of 1995, 1996).

For the USAF, in a proactive move to improve protection for USAF people and resources, Air Force Policy Directive 32-20*: Fire Protection* (1994), was written to guide fire protection policy within the USAF, prior to the enactment of The National Technology Transfer and Advancement Act of 1995. This directive says, "The Air Force will ensure its fire protection operations comply with all applicable national, state, local, and Department of Defense (DoD) regulations, as well as National Fire Codes published by the National Fire Protection Association (NFPA)" (USAF, 1994, p. 1).

Following correspondence between the US Navy and OSHA, John Plummer (1997) issued a formal interpretation on the wear of proximity gear for airport firefighters. In his interpretation he said, “In 1992, the NFPA promulgated NFPA 1976, Standard on Protective Clothing for Proximity Firefighting, which does address the issue and which requires aluminized proximity protective clothing for aircraft firefighting” (p. 1). He went on to say “…an employer may be cited for failure to follow NFPA 1976” (pp. 1-2). Though the intent of Plummer’s statement is understood, he inaccurately cited NFPA 1976 as the standard requiring proximity gear for aircraft firefighting. The correct standard that requires the wear of proximity gear is NFPA 1500 (NFPA, 1997b), “…1976 is a product standard for this equipment” (Riecher, 1999, p. 12).

The only recognition given to airport fire departments that respond to aircraft incidents, but at a rate less frequent than their structural responsibilities, is in the determination that “…where aircraft crash and rescue is less than 5 percent of the tasking, then proximity firefighting is ‘incidental’ and not the primary job” (Riecher, 1999, p. 12).

NFPA 1500 (NFPA, 1997b) clearly requires a risk management plan for all department functions:

> The fire department shall develop and adopt a comprehensive written risk management plan. The risk management plan shall consider all fire department policies and procedures…The risk management plan shall at least cover the risks associated with the following:…(e) Protective clothing and equipment, (f) Operations at emergency incidents… (section 2-2).

The components of a risk management plan include risk identification, risk evaluation, risk control and risk management monitoring (NFPA, 1997b). Another standard that specifically addresses the importance of risk management is NFPA 1521 (NFPA, 1997c). In the Appendix (Section A-3-1.1, 1997), it says, "Risk management is a vital component to any organization's operation, especially a fire department."

2. Is there a risk management tool available for the fire chief's use?

Research revealed a wide array of resources available on the Internet in the form of agencies and programs available to teach risk management, conduct risk management surveys, and provide guidance in developing risk management programs. Appendix B provides a sample list of resources available for addressing risk management issues. In an effort to "…maximize combat capability...", the USAF developed its own risk management program and entitled it "Operational Risk Management (ORM)" (USAF, 1998, p. 4). Because of the author's familiarity with this specific risk management program, and the purpose it serves to provide an example of a program that is available for use, this is the primary risk management program that will be addressed throughout this paper.

ORM is defined as "…a logic-based, common sense approach to making calculated decisions on human, materiel, and environmental factors before, during, and after Air Force mission activities and operations…" (USAF, 1997, p. 1). Developed in September 1996, the ORM program underwent a substantive revision in 1997 to provide "…a process that will allow greater and more consistent results by using a systematic method rather than relying solely on experience" (USAF, 1998, p. 4). Its

fundamental goal is to “enhance mission effectiveness at all levels while preserving assets and safeguarding health and welfare” (p. 5).

The application of ORM procedures is taught at Kirtland Air Force Base (AFB), New Mexico, at the Air Force Safety Center, and through the use of traveling training teams. All supervisors in the USAF have received a basic level of training in ORM, though many have completed the residence course at Kirtland AFB. The training conducted at the Air Force Safety Center focuses on four key principles;

(1) Accept no unnecessary risks.

(2) Make risk decisions at the appropriate level.

(3) Accept risks when benefits outweigh costs.

(4) Integrate ORM into doctrine and planning at all levels (USAF, 1998).

ORM is now the standard by which USAF fire departments address safety and health issues, and decreased response capabilities (USAF, 1999). When an area is identified as being non-compliant with the established standard, an ORM plan (see Appendix C) must be prepared and submitted through the chain-of-command to the appropriate approval level, the Authority Having Jurisdiction (AHJ). Air Force Instruction 32-2001: *Fire Protection and Fire Prevention Program* (1999), describes the AHJ according to the type of situation being confronted. For permanent deviations to NFPA standards, the Air Force Civil Engineer is the appropriate level of approval. This person, a major general, is the highest ranking person in the fire protection chain-of-command. For long-term deviations (more than 18-months), the major command civil engineer is the approval authority. In USAFE this is a colonel, who provides leadership and direction to all USAF fire departments in Europe. Short-term deviations (less than

18-months), can be approved by the installation commander, normally a colonel or a brigadier general. The installation commander is responsible for the effective operation of a wing s part of the United States' national security policy (USAF, 1999).

3. What types of protective clothing are available?

There are basically two types of firefighter PPE; structural and proximity gear. There are several different fabrics that can be used to make either, such as Nomex, Kevlar, and PBI, but the PBI product being marketed today seems to be the material of choice by fire departments. As with other fabrics, PBI can be used to produce either type of PPE.

To gain insight on the types of fabrics being used to produce firefighter PPE, Tammy Wells of Total Fire Group was contacted and asked to provide information on the types of PPE available and the fabrics being used. She provided detailed information on Morning Pride gear, the preferred PPE for many USAF fire departments, including RAF Mildenhall. Though the information she provided on PPE features was specific to Morning Pride, the data on the materials used to produce the PPE reflects the industries' standard materials and can be found in almost all brands of gear. The variations in gear are found not in the materials used to produce them, but in the features of the gear. For that reason, the information provided by Ms. Wells will be used to explain the qualities of structural and proximity gear for the purposes of this research.

Nomex and PBI are the basic materials used in PPE construction. Nomex is inherently flame resistant and will not melt, drip or char at temperatures up to 750 degrees F (Total Fire Group, 1999). Nomex, though it will withstand high temperatures,

once it is charred it will begin to breakdown and disintegrate with movement. PBI is an "…engineered blend of PBI and Kevlar" (Total Fire Group, 1999, p. 25). It was originally developed as part of the Project FIRES research to provide a material that supplied better protection than Nomex, at higher temperatures. "PBI will resist charring up to temperatures that exceed the firefighters' biological capabilities" (Total Fire Group, 1999, p. 25).

Proximity gear manufactured by Morning Pride is limited to aluminized PBI. This material is a 33% PBI and 67% Kevlar knit. This combination of materials significantly reduces cracking of the aluminized material found in conventional woven proximity gear (Total Fire Group, 1999).

4. What standards address firefighter safety and health?

NFPA 1500 (NFPA, 1997b) is the basic standard for all firefighter safety and health issues. "This standard contains minimum requirements for a fire-service-related occupational safety and health program" (section 1-1). The purpose of NFPA 1500 (NFPA, 1997b) is to specify minimum requirements for occupational safety and health, and to specify safety guidelines for members involved in rescue, fire suppression, emergency medical services, hazardous materials operations, special operations, and related activities. Firefighter safety and health is so important to a fire department's operations, NFPA 1500 (NFPA, 1997b) specifically requires that a Health and Safety Officer (HSO) be appointed to manage the department safety program. "The fire department health and safety officer shall be responsible for the management of the occupational safety and health program" (NFPA, 1997b, section 2-5).

NFPA 1500 (NFPA, 1997b) is divided into 10 chapters. These chapters cover administration; organization; training and education; vehicles, equipment, and drivers; protective clothing and protective equipment; emergency operations; facility safety; medical and physical requirements; member assistance programs; and the critical incident stress program.

Chapter 5 specifically deals with protective clothing and protective equipment. This chapter addresses not only structural and proximity gear, but includes work station uniforms; infection control requirements in accordance with (IAW) NFPA 1581, *Standard on Fire Department Infection Control Program*; breathing apparatus and respiratory protection IAW NFPA 1404, *Standard for a Fire Department Self-Contained Breathing Apparatus Program*; chemical protective suits; wildland firefighting clothing; ropes; eye and face protection; and hearing conservation programs. The areas of this chapter that address structural and proximity gear focus on the requirements of NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting*, for structural gear, helmets, boots and gloves, and NFPA 1976, *Standard on Protective Clothing for Proximity Fire Fighting*, for proximity gear. It also identifies wear requirements of the gear.

Several other NFPA standards address firefighter safety in a variety of forms. According to Section 3-2.2.2 of NFPA 1561 (NFPA, 1997d), *Standard on Fire Department Incident Management System*, the HSO shall have the authority to alter, suspend, or terminate activities that he/she judges to be unsafe or involve an imminent hazard. NFPA 1021 (NFPA, 1997a), *Standard for Fire Officer Professional Qualifications*, states, “One of the fire officer’s primary responsibilities is safety both on

the fire ground and during normal operations…" (section A-2-7). NFPA 1521 (NFPA, 1997c), *Standard for Fire Department Health and Safety Officer*, identifies the duties of the HSO as; requiring a knowledge of current laws, codes and standards; occupational safety and health hazards involved in emergency operations; current principles and techniques of safety management; current health maintenance and physical fitness issues; and infection control practice and procedures. The HSO must also identify and correct safety and health hazards, and imminent hazard situations. In nonimminent hazard situations, the HSO must develop actions to correct the situation within the administrative process of the department.

A survey was developed and sent to 176 USAF fire departments to attempt to assess the level of protection provided to the firefighters in these departments, whether PPE requirements had changed as a result of the OSHA interpretation, and what injuries, if any, had been sustained by firefighters in their department as a result of wearing "inappropriate" PPE.

Forty-five fire departments responded to the survey, which equates to 26% of the departments in the USAF. Of the departments that responded to the survey, 20 protect large frame aircraft operations, such as C-5 cargo aircraft; 9 departments protect small fighter aircraft missions; 4 have other missions, such as missiles; and 12 protect both large and small frame aircraft operations.

The protective clothing worn by these 45 departments is overwhelmingly proximity gear. Twenty-seven departments wear proximity gear exclusively, 15 wear both proximity and structural gear, and 3 wear only structural gear. Of the 27 departments that wear proximity gear exclusively, they were asked if they had ever worn structural

gear. Three responded they had and had all changed to proximity gear within the last three years. Their reasons for changing were the NFPA 1500 (NFPA, 1997b) requirement for airport firefighters to wear proximity gear, risk assessment, and the OSHA requirement as stated in Plummer's (1997) interpretation.

The three departments that indicated they use structural gear only were asked why they have not changed. They responded that structural gear provides the necessary level of protection for their mission.

The next question focused on whether any of these fire departments had ever had anyone injured in a fire operation. Eight indicated they had and 37 had not. Of the eight who had, two were injured in structure fires, three in aircraft fires, one during training, one aboard a ship, and one during a combined aircraft and structural fire. Not a single one of the injuries sustained was a result of wearing structural protective clothing.

The final question asked the respondents whether they believed proximity gear was required for all aircraft firefighting operations. Twenty-three indicated they did, with 22 saying they did not believe proximity gear was necessary in all aircraft firefighting situations.

The questionnaire clearly indicates that fire chiefs have not had firefighters injured in aircraft firefighting operations while wearing structural protective clothing, and that even though fire departments have been wearing proximity gear for several years, nearly half of the respondents don't believe proximity gear is required for all aircraft firefighting operations.

DISCUSSION

Firefighter safety, whether in the firehouse or on the incident scene, has emerged as one of the most important issues in the fire service over the past two decades. Since the first edition of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, was issued in 1987, the number of fire fighter fatalities has continued to decline, with the exception of 1994 (NFPA, 1997b). But, there is still much to be done. Safety can't be dictated by regulations or standards alone (NFPA, 1997b). The human factor always presents an unknown variable, so it is important for people to constantly apply safety to their personal and professional lives.

Jackson (1998) noted that safety is important and reaps many rewards for the fire service:

> Over the last 10 years, fire departments have been placing emphasis on operating their organization as a business. Many organizations, including the USAF, have focused on "Total Quality Management" and applied the Malcolm Baldrige National Quality Awards criteria to their "business" to assess the level of quality service being provided to the members of their community. Fire chiefs have written books on customer service, the most well known being Alan Brunicini of the Phoenix, AZ, Fire Department. His approach to providing fire protection to the City of Phoenix appears to be considered "good business" based on his success as a lecturer and author. Providing for the safety of department members is not only good business, it also protects the jurisdiction from litigation, reduces lost time due to injury, and reduces

> medical expenses and overtime costs to fill vacant positions. Safety is indeed good business (pp. 21-22).

Meyer (1992) observed that, “Opinions on NFPA 1500 vary, but as a nationally recognized standard, it cannot be ignored. It is a reference document to which any department will find itself compared in issues of litigation involving personnel protection” (p. 44).

As the base document for firefighter safety, NFPA 1500 (NFPA, 1997b) refers to numerous other NFPA standards regarding safety issues from medical responses to protective clothing and equipment. Many of these documents set criteria for manufacturers to follow, then NFPA 1500 (NFPA, 1997b) requires the product to be used. For example; NFPA 1976 (NFPA, 1992), is “…a product standard” (Riecher, 1999, p. 12). It outlines the requirements that must be met by manufacturers in the production of NFPA 1976 compliant protective clothing. NFPA 1500 (NFPA, 1997b) then applies the requirements of NFPA 1976 for airport fire fighters by saying:

> Members who engage in or are exposed to the hazards of proximity fire fighting shall be provided with and shall use both proximity protective coats and proximity protective trousers, or a proximity protective coverall, for limb/torso protection. The proximity protective coat and proximity protective trousers, or the proximity protective coverall, shall meet the applicable requirements of NFPA 1976, Standard on Protective Clothing for Proximity Fire Fighting (section 5-4).

The same procedure is used for structural fire fighting protective clothing, helmets, boots, gloves, medical clothing, etc.

There are other NFPA standards that have safety requirements but don't address clothing or equipment. According to NFPA 1561 (NFPA, 1997d), a Health and Safety Officer (HSO) shall have the authority to alter, suspend, or terminate activities that he/she judges to be unsafe or involve an imminent hazard (section 3-2.2.2). NFPA 1521 (NFPA, 1997c) identifies the duties of the HSO as; requiring a knowledge of current laws, codes and standards; occupational safety and health hazards involved in emergency operations; current principles and techniques of safety management; current health maintenance and physical fitness issues; and infection control practice and procedures. The HSO must also identify and correct safety and health hazards, and imminent hazard situations. In nonimminent hazard situations, the HSO must develop actions to correct the situation within the administrative process of the department. NFPA 1021 (NFPA, 1997a) indicates that, "One of the fire officer's primary responsibilities is safety both on the fire ground and during normal operations…" (section A-2-7). This illustrates that safety is an integral part of leadership and is taught from an early age within fire protection. It provides fire officers with more awareness for safety issues, but it also arms them with the knowledge of the importance safety plays in fire fighting (Jackson, 1998).

An area of safety that is also addressed by NFPA standards is risk management. In fact, risk management is mandated by NFPA 1500 (NFPA, 1997b), which says:

> The fire department shall develop and adopt a comprehensive written risk management plan. The risk management plan shall consider all fire department policies and procedures…The risk management plan shall at least cover the risks

> associated with the following:…(e) Protective clothing and equipment, (f) Operations at emergency incidents…(section 2-2).

The components of a risk management plan include risk identification, risk evaluation, risk control and risk management monitoring (NFPA, 1997b). Another standard that specifically addresses the importance of risk management is NFPA 1521 (NFPA, 1997c). In the Appendix it says, "Risk management is a vital component to any organization's operation, especially a fire department" (section A-3-1.1).

What is risk management? NFPA 1500 (NFPA, 1997b) defines risk management as, "Identification and analysis of exposure to hazards, selection of appropriate risk management techniques to handle exposures, implementation of chosen techniques, and monitoring of results, with respect to the health and safety of members" (section 1-5). Within the USAF, there is a risk management program that has been developed to "…maximize combat capability..." (USAF, 1998, p. 4). This program is called Operational Risk Management (ORM) and it was developed to provide "…a process that will allow greater and more consistent results by using a systematic method rather than relying solely on experience" (USAF, 1998, p. 4). Its fundamental goal is to "…enhance mission effectiveness at all levels while preserving assets and safeguarding health and welfare" (USAF, 1998, p. 5).

Whatever risk management program is used, it must be acceptable to everyone that must use it. Chris Preu (1997) confirms this when he stated:

> To be effective, the hazard assessments need to be conducted in a uniform manner and, at a minimum, in compliance with the Occupational Safety and Health Administration (OSHA), Subpart I – Personal Protective Equipment, and NFPA

> 1500, Standard on Fire Department Occupational Safety and Health Program. To insure uniformity of quality, the method must include a numerical evaluation of the likelihood and probable severity of injurious conditions (p. 34).

So, there is a program available for use by the RAF Mildenhall Fire Department to use to determine what type of protective clothing is appropriate for wear by members of the department, but it can't be used. Or can it? "…the responsibility for choosing the right PPE should rest with the person best suited to evaluate the risks at the fire scene and take the appropriate action to protect life and property--the incident commander" (Riecher, 1999, p. 24). "With any selection of protective equipment, fire departments must carefully review their needs and determine what will be an appropriate level of protection" (Teele, 1997, p. 19). These professionals have determined, and believe, that risk management is a key element to any safety program.

NFPA 1500 (NFPA, 1997b) clearly requires airport firefighters to wear proximity protective clothing, but it also says that risk management must be applied to provide for the safety and health of the members. John Plummer, OSHA Director of Federal Agency Programs (1997), issued an interpretation that said, "In 1992, the NFPA promulgated NFPA 1976…which requires aluminized proximity protective clothing for aircraft firefighting" (p. 1). He went on to say, "…an employer may be cited for failure to follow NFPA 1976" (p. 2). This statement is inaccurate because "…1976 is a product standard…" and does not require the wear of proximity protective clothing (Riecher, 1999, p. 12). NFPA 1500 (NFPA, 1997b) actually requires the wear of proximity protective clothing for airport fire fighters (section 5-4). So, we are back where we started with no clear rationale for the exclusion of risk management.

According to Randy Lawson, National Institute of Standards and Technology (personal communication, August 10, 1999), “Injury statistics on the use of various types of Personal Protective Equipment (PPE) are not available. Regrettably, people responsible for keeping statistics on firefighter injuries don’t breakdown injury data according to the use of PPE.” Rita Fahy, NFPA staff member (personal communication, August 23, 1999), recalls that she “…can’t think of any firefighter deaths in the last 20 years during aircraft firefighting.” In fact, burn injuries can’t be specifically identified as being attributed to aircraft fire fighting. Division Chief Kirk Owen (1996), Plano Fire Department, points out that, “Unfortunately, thorough investigations are not usually conducted on burn injury incidents. Thus, it is difficult to determine the factors that contributed to the injury” (p. 9).

There is scientific data available regarding structural PPE and proximity PPE, but there are contradictions in that data also. The International Fire Service Training Association instructs firefighters that, “Proximity suits are designed for close proximity exposures to flame (not direct flame contact) and radiant heat temperatures as great as 932 degrees F (500 degrees C) for five minutes or more” (IFSTA, 1995, pp. 29-30). A jet fuel fire, burning in the open air, will produce temperatures as high as 3,800 degrees F, so will proximity gear protect fire fighters adequately (J. R. Lawson, personal communication, August 17, 1999)? Based on IFSTA educational material, no. Larry Williams (1989), a training consultant for aircraft fire operations, explains that 90% of radiant heat is reflected by proximity gear. That would mean that a fire burning at 3800 degrees F would only result in 380 degrees F actually being felt inside the firefighters’

proximity gear. Using this example, proximity gear will provide adequate protection based on IFSTA's resources.

Harry Winer, a scientist with the US Navy Clothing and Textile Research Facility, and secretary of the NFPA 1976 committee, explains, "The most effective barrier for stopping radiant heat is a metalized surface that reflects it away rather than allows it to be absorbed through the fabric" (Riecher, 1999, p. 12). Based on Williams' evaluation we would have to agree. But how long will that reflectivity last is unknown. According to John Schenck, president of Southern Laboratories, "Realistically, if you took any set of aluminized gear out there that has been used (for firefighting), it probably doesn't meet standards anymore" (Riecher, 1999, p. 22). That is an expensive problem for airport fire departments because proximity gear can be "…up to 30% more expensive than structural gear…" (Riecher, 1999, p. 22). The delicate nature of proximity gear also raises concerns with Schenck. "It's as close as you can get to throw-away protective clothing and still not call it throw-away protective clothing" (Riecher, 1999, p. 22).

Structural protective clothing has advantages and disadvantages over proximity gear. "Protective clothing commonly worn for structural firefighting helps to make rescue aboard an aircraft quicker and more efficient" (Williams, 1989, p. 57). It is made of the same material as proximity gear, but without the reflective outer layer. Schenck says:

> By comparison, it is not unusual for structural fire gear as much as 15-years old to still be in use. Firefighters typically retire structural fire gear before it wears out, simply to take advantage of the newest innovations in PPE" (Riecher, 1999, p. 22).

PBI will "…resist charring up to temperatures that exceed the firefighters' biological capabilities" (Total Fire Group, 1999, p. 13). So, it is arguable that structural gear made of PBI appears to provide adequate levels of protection for airport firefighters. But, according to Stephen Foley, NFPA Senior Fire Service Specialist and Staff Liaison to the NFPA 1500 committee, structural gear won't protect a firefighter adequately. "…If you have the wings or center belly tank rupture and you have flammable liquid spill, your structural firefighting gear is not going to afford you a level of protection to fight that" (Riecher, 1999, p. 13). Williams (1989) brings forward another issue revolving around the use of structural gear for proximity firefighting. "Structural gear does not perform particularly well against radiant heat. Steam burns are a constant hazard…" (p. 56). Simply because there is a hazard doesn't mean an action should be eliminated. Based on 1998 injury statistics, five firefighters died from burns in 1998, but none were involved in aircraft firefighting at the time of the injury (Washburn, LeBlanc and Fahy, 1999). In 1997, burns accounted for 9.2% of firefighter injuries, and exposure to fire products accounted for 14.7% (Karter and LeBlanc, 1998). None of these figures involve aircraft firefighting, so understanding the rationale behind the decision to require all airport firefighters to wear proximity gear is still unclear and seemingly very subjective.

If steam burns are a hazard, yet none have occurred, what is the process by which the burns occur is a question that must be addressed. According to Williams (1989), "The radiant heat penetrates the suit and the moisture from the body inside the suit turns to steam, causing second-and third-degree burns to the skin" (p. 56). He went on to say that by the time "…you feel the heat inside the structural clothing, it is too late" (p.

56). Many physiological occurrences take place before a firefighter gets to the burn stage while wearing structural gear. Lawson (1996) concurs that, “Once sweating has begun, firefighters become susceptible to injuries referred to as steam or scald burns” (p. 7). Lawson (1996) also explained that the trapped moisture inside the suit may cause a decrease in thermal protective performance of the suit, especially where the fabric is compressed; “…Compression of protective clothing will accelerate heat transfer through the clothing and may cause heat stored in garments to be immediately transferred to the skin resulting in a burn” (p. 18). This occurs at the shoulders and neck where the breathing apparatus is worn, at the elbows, knees, and groin area. Lawson explains the reason for the transfer of heat in this way:

> …thermal protection provided by their protective clothing is generally altered by moisture inside these garments, which includes wet uniforms and underwear. Preheating increases heat energy levels in a fire fighters’ protective clothing, and sweating may increase heat flow and heat storage in protective clothing (p. 18).

Lawson (1996) goes on to say that structural fire fighter protective clothing will absorb almost all, 80 to 100 percent, of the radiant heat released from a fire. Regardless how far away you move from the fire, structural gear will still absorb the same amount of radiant heat, albeit the level of radiant heat will diminish as you move further from the heat source. He provided a sobering example:

> I presently have a set of turnout gear sent to me by a fire department that was ignited only by thermal radiation. The fire fighter was some 10 to 20 feet away from the flames coming from a warehouse when his protective clothing ignited from thermal radiation. His modern fire fighters protective clothing was never touched by

a flame but started burning. The fire fighter was burned in the process (personal communication, August 17, 1999).

So high radiant heat fires and resulting injuries aren't exclusive to proximity fire situations, yet there is a separate standard for proximity protective clothing, and a "hands tied" interpretation that prevents effective use of risk management concepts. "A 30 second exposure to the environment created by a 600 kW room fire could cause burn injuries to a fire fighter on the corridor floor 6 meters (20 feet) away from the fire room door" (Lawson, 1996, p. 13). That is a hot fire and tremendous amount of radiant heat, yet because it is a structural fire structural gear is acceptable. Even though injuries from burns occur from these types of fires and are well documented by NFPA, and by comparison there are none documented from aircraft firefighting, there is no change in structural gear or protection required for structural firefighting on the horizon. As a result, the rationale for the NFPA 1976 standard and subsequent OSHA interpretation doesn't ring clear.

This further highlights the fact that protective clothing isn't the only factor that must be considered when evaluating operational safety. "…Well managed, highly trained, closely supervised, and properly staffed fire departments are equally essential elements of safety in order to minimize the operational risk" (Teele, 1997, p. 18).

Risk management is essential to effective fire department operations and is applied to those operations across the United States. Take for example a city fire department that responds to a fuel tanker on fire where the vehicle is transporting huge amounts of flammable liquids and is engulfed in a tremendously high radiant heat fire. The city fire department is going to attack the fire wearing structural gear because that's all they

have. And as past performance shows, they will be successful. So is proximity gear needed for this hazard or does risk management eliminate the need? Foley asks the same question, “Suppose a gasoline tanker truck overturned and exploded in your community? Would small municipal fire departments have to be prepared by having aluminized gear on hand” (Riecher, 1999, p. 13)? As a senior member of the NFPA and the NFPA 1500 committee liaison, this question raised by Foley clearly shows the dilemma the entire fire service is in over this issue. However, history would indicate that risk management is the answer and has been for many years. The FAA applies this logic to their firefighting requirements at airports by recognizing that “…firefighters do not need to leave the ARFF vehicle before the levels of radiant heat are low enough to allow the use of non-reflective gear” (FAA, 1995, p. 4). They also say in the same document, “…As with any protective clothing, training and education need to be conducted to educate firefighters concerning proper use, care, and PPE limitations” (p. 4). Teele (1997) agrees:

> …If the operation is successful in quickly ‘knocking down’ the fire, then the environment should improve and temperatures decrease…With any selection of protective equipment, fire departments must carefully review their needs and determine what will be an appropriate level of protection (p. 17).

IFSTA (1995) teaches firefighters that in aircraft firefighting, “The primary goal in controlling the fire is to establish escape or rescue corridors” (p. 133). To do this, firefighters must quickly control the fire area and establish the rescue corridor through a mass application of an extinguishing agent (IFSTA, 1995). Reaching this goal means, “…it is necessary to first control any fire that poses a threat to the victims or the

rescuers" (IFSTA, 1995, p. 133). Once the main body of fire is knocked down and rescue starts, handlines should be used for backup, interior attack and overhaul (IFSTA, 1995). Interior attack and rescue are areas that Williams (1989) is concerned with when firefighters wear structural gear. Once the fire is extinguished "…and firefighters are involved in close-range operations, there is no guarantee that a large flash fire could not occur…This is a strong argument in favor of proximity gear" (p. 56). IFSTA (1995) agrees and says, "Because the radiant heat produced by burning aircraft fuels can be extreme, it is not recommended that structural clothing be used instead of proximity suits…for aircraft firefighting whenever there is a choice" (p. 28).

What is the answer? There is an abundant amount of information available to support an argument for proximity gear and to support the use of structural gear in aircraft firefighting operations. Meyer (1992) observed that, "Opinions on NFPA 1500 vary, but as a nationally recognized standard, it cannot be ignored. It is a reference document to which any department will find itself compared in issues of litigation involving personnel protection" (p. 44). Therein lies the contradiction. The standard says you must wear NFPA 1976 compliant gear for proximity firefighting, but it also says that risk management must be applied to all areas of the department, to include protective clothing. You can't have it both ways.

RECOMMENDATIONS

Fire chiefs should continue to challenge the issue of proximity gear use versus structural gear in aircraft firefighting operations. If they have developed a sound risk management program, such as the one developed by the USAF, and apply it in a logical, methodical and quantifiable way, the resulting decision should be acceptable to the Authority Having Jurisdiction.

It is also necessary for the Department of Defense to readdress the interpretation provide by John Plummer of OSHA and apply not only risk management techniques, but also include the requirements of NFPA 1500. This will show that the fire chief is the best person to assess his/her department and operational needs, then select the most appropriate level of personal protection. Does an airport that has small Cessna aircraft need firefighters protected to the level airports that handle Boeing 747s need their firefighters protected too? That is the level of rationale that must be applied by OSHA to this issue before it will make sense and be fully accepted.

Further study of this issue could be undertaken to better document how US fire departments are dealing with the proximity gear requirement and their application of risk management. Including more departments on the mailing list for the questionnaire would incorporate a wider field of data. Additionally, the questionnaire could be expanded to; (1) gauge the level of risk management applied by those departments that have chosen to remain protected by structural gear for aircraft firefighting, and (2) determine what gear departments currently in proximity gear would choose if they were given the opportunity to apply risk management to their PPE needs.

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APPENDIX A
FIREFIGHTER PROTECTIVE CLOTHING SURVEY

Thank you for taking a few minutes to complete this survey. The results will be used in my research to evaluate the use of proximity protective clothing in aircraft firefighting operations versus structural turnouts.

The information you provide will be kept confidential and will only be seen by myself in the preparation of the research paper. No specific references will be made to any person, department, base, or command.

1. What is your primary mission?

    A. Aircraft – Large Frame
    B. Aircraft – Small Frame
    C. Both large and small frame aircraft
    D. Structural
    E. Missiles
    F. Other: _____

2. What type of bunker gear do your firefighters wear?

    A. Structural turnouts
    B. Proximity gear
    C. Both

If you answered “B”, please continue from question 3. If you answered “A”, please skip to question 6. If you answered “C”, please skip to question 7.

3. Have your firefighters ever worn structural turnouts only?

    A. Yes
    B. No

If you answered “yes”, please continue from question 4. If you answered “no”, please skip to question 7.

4. How long ago did you change your gear?

    A. Less than one year
    B. 1-2 years
    C. 2-3 years
    D. Over 3 years

5. Why did you change to add proximity gear?

A. OSHA requirement
B. Risk assessment
C. NFPA 1500 requirement
D. Other: _____

6. If you have stayed with structural turnouts rather than changing to proximity gear or a combination of both, why have you chosen to do that?

A. Risk assessment
B. Structural turnouts provide necessary level of protection
C. Large-volume turrets reduce fire to adequate level for structural turnout use
D Other: _____

7. Have you ever had anyone injured during a fire?

A. Yes
B. No

If you answered “yes” to question 7, please answer questions 8 - 10. If you answered “no”, please skip to question 10.

8. What type of fire were they fighting at the time of the injury?

A. Aircraft
B. Structure
C. Other: _____

9. Were their injuries a result of wearing structural turnouts?

A. Yes
B. No

10. Do you believe proximity gear is required for all aircraft firefighting?

A. Yes
B. No

APPENDIX B
A BIBLIOGRAPHY OF RISK MANAGEMENT KEY REFERENCES

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(212) 922-0716

2. *Risk Analysis Guide: Exposure Questionnaire for Risk Managers*. Published by the Risk Management Society Publishing Inc., 205 East 42nd Street, New York, NY 10017. (212) 286-9292. A comprehensive checklist of all conceivable aspects of risk.

3. The Dan Petersen video series. The Challenge of Change -- Creating a New Safety Culture. Distributed by Safety Training Systems, Creative Media Development Inc. 710 W. Ninth Avenue, Portland, OR 97205, 1-800-537-8352. Detailed guidance on procedures for changing culture. Includes the computer-based perception survey and authority to use it at one site.

4. The Dan Petersen Safety Management Series. Same source as 3. Contains the detailed elements of the Petersen approach. Five videos and an excellent printed guide.

5. *Analyzing Safety System Effectiveness, 3rd Edition*, published by Van Nostrand Reinhold, 115 Fifth Avenue, New York, NY 10003, 1996. An excellent and comprehensive reference on the safety measurement process, especially the perception survey.

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APPENDIX C
OPERATIONAL RISK MANAGEMENT PLAN

Host Nation Firefighter Certification		
REVIEW TEAM CMSgt Pitrat (HQ USAFE/CEXF) CMSgt Soto (31 CES/CEF)	TYPE OF REVIEW Deliberate	DATE OF REVIEW 1-30 April 99

DESCRIPTION OF PROPOSED CHANGE

The Air Force has established a new criterion requiring host nation firefighters to be certified in accordance with the Department of Defense Fire and Emergency Services Certification Program. The references for this new requirement are; AFMAN 32-2003, Air Force Firefighter Certification Program, AFI 32-4002, Hazardous Materials Emergency Planning and Response Program, and the Computer-Based Testing Procedure Guide and AFI 32-2001, The Fire Protection Operations and Fire Prevention Program. This new requirement makes it mandatory for host nation firefighters to obtain certification in accordance with AFI 32-2001, The Fire Protection Operations and Fire Prevention Program.

Step 1 Hazard Identification – Change Analysis

FACTORS	EXISTING	PROPOSED	SIGNIFICANCE
Host nation firefighter certification	Host nation firefighters not certified	Fire Chiefs will use the training program in AFI 32-2001, The Fire Protection Operations and Fire Prevention Program, to develop a training program for host nation firefighters not certified	Does not meet AFI 32-2001, The Fire Protection Operations and Fire Prevention Program -- Standard requires certification Fire fighting certification may affect aircraft, structural fire fighting, and driver/operator capabilities Firefighters may not function as an effective fire fighting team Firefighters may not rescue personnel effectively Firefighters may not control and extinguish fires effectively

Step 2 Risk Assessment

Step 2A. Assessment			Step 2B. Prioritization		
PROBABILITY	SEVERITY	HAZARD	RANK	LEVEL	RISK
Seldom	Cat	Host nation firefighters may not be able to rescue personnel during aircraft crash rescue and structural fire fighting incidents	1	H	Aircrew members may be injured or killed Facility occupants may be injured or killed Mission failure

Seldom	Cat	Host nation firefighters may not function as an effective fire fighting team during aircraft crash rescue and structural fire fighting incidents	2	H	Firefighters may be injured or killed Damage to or destruction of fire fighting equipment Mission failure
Seldom	Cat	Host nation firefighters may not be highly proficient in fire fighting vehicle driver operations	3	H	Firefighters may be injured or killed Fire fighting emergency vehicles may be damaged or destroyed Mission failure

LEGEND		
PROBABILITY Frequent, Likely, Occasional, Seldom, Unlikely	SEVERITY Cat = Catastrophic, Crit = Critical, Mod = Moderate, Neg = Negligible	RISK EH = Extra High, H = High, M = Moderate, L = Low

Step 3 Analyze Risk Control Measures

Rank #	Macro	Control Measure	Cost
1-3	REDUCE and SPREAD	Maintain the DoDI firefighter certification program with associated risks and use the fire chief's training program to train host nation firefighters until certification programs Firefighter I/II, Airport Firefighter and Driver/Operator, CerTest, and CDC end of course examinations, are translated into host nation language, and the British MOD training programs are evaluated for acceptance by International Fire Service Accreditation Congress (IFSAC). Continue to encourage host nation firefighters to enroll in the English versions of the DoD certification program.	$160K For host nation and CerTest translation

Step 3 Risk Control Options

Package A

Accept the new requirement to have host nation firefighters certified to meet the requirements of the DoD firefighters certification program. Reduce and spread the associated risk by having the fire chiefs develop firefighter training programs to train host nation firefighters to the same standards as required by the DoD certification program. Fire chiefs will use this program until reference material and CerTest for Firefighter I/II, Airport Firefighter, Driver/Operator Structural and Aircraft Fire Rescue are translated into host nation language. British MOD firefighters will follow locally developed training programs until RAF Manston training programs are evaluated for accreditation by IFSAC to determine

if they are obtaining certification in accordance with (IAW) AFI 32-2001, The Fire Protection and Fire Prevention Program.
STEP 4 Make Control Decisions
DECISION LEVEL Based on the evaluation, the risk associated with host nation firefighters not being certified to AFI 32-2001 requirements is minor and the compensation measure will ensure host nation firefighters are trained to perform the fire protection mission. **HQ USAFE CE/CC _____ Date_____**
STEP 5 IMPLEMENTATION
Implementing the reduction and spreading measures will ensure host nation firefighters can effectively perform their fire-fighting mission. Package A's proposal requires implementation of a fire chief's host nation training program with the approval of the USAFE Civil Engineer if not complying with AFI 32-2001, The Fire Protection and Fire Prevention Program.
STEP 6 SUPERVISION AND REVIEW
USAFE Civil Engineer will monitor the progress of the wavier/variance. USAFE will continue reviewing current capabilities using collected data from measuring instruments such as fire incident reports, number of aircraft emergencies, and cost factors along with other measuring tools, to reveal any trends or problems areas. Anytime additional factors change the current operation in either a positive or negative way, this ORM will be reviewed. This includes the introduction of new technology or change of missions, standards, or aircraft operations.