Report on Tire Fires

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Committee on Commerce, Science, and Transportation
United States Senate

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Prepared by

United States Fire Administration
Federal Emergency Management Agency

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Report on Tire Fires
As Requested by the
Fire Administration Authorization Act of 1997
(PL 105-109)

Purpose

The Federal Emergency Management Agency's (FEMA) United States Fire Administration (USFA) submits this report to the Senate Committee on Commerce, Science, and Transportation in response to a requirement in the Fire Administration Authorization Act of 1997, P.L.105-109:

Sec.8.Report to Congress

(a) In General. -Not later than 180 days after the date of enactment of this Act, the Administrator of the United States Fire Administration (referred to in this section as the "Administrator") shall prepare and submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science of the House of Representatives a report that meets the requirements of this section.

(b) Contents of Report. -The report under this section shall -

(1) examine the risks to firefighters in suppressing fires caused by burning tires;

(2) address any risks that are uniquely attributable to fires described in paragraph (1), including any risks relating to -

(A) exposure to toxic substances (as that term is defined by the Administrator);

(B) personal protection;

(C) the duration of those fires; and

(D) site hazards associated with those fires;

(3) identify any special training that may be necessary for firefighters to suppress those fires, and

(4) assess how the training referred to in paragraph (3) may be provided by the United States Fire Administration.

Tire Fires: A Report to Congress

Executive Summary

The Fire Administration Authorization Act of 1997 (P.L. 105-109) included a requirement that the Federal Emergency Management Agency's (FEMA) United States Fire Administration (USFA) conduct a study on tire fires and the risks they present to firefighters during suppression activities. The results of the study, conducted in 1997-98, indicate that the hazardous characteristics of tire fires present a unique set of risks to firefighters. Exposure to toxic substances at tire fires, personal protection requirements, fire duration, and site hazards encountered at tire fires all contribute to firefighter risk.

Special training that may be required for firefighters who suppress tire fires and how such training might be provided by the USFA also were addressed in this report. Although no courses have been developed specifically for tire fires, a number of courses that deal with fire incidents involving hazardous materials can be applied to problems presented by tire fires. Courses are available at the National Fire Academy's (NFA) Emmitsburg campus, through off-campus offerings at State and local training facilities, and are available for purchase through the National Technical Information Service (NTIS).

Although the impact of tire fires on firefighters and communities can be severe, these fires do not have to occur. Safe tire storage is an essential factor upon which a successful mitigation program may be built. Tire storage programs in the United States are diverse, and local fire departments must know what the local and State requirements for scrap tire storage are in their jurisdiction. Knowledge of government legislative and enforcement responsibilities and the responsibilities of industry are essential in allowing fire department personnel to understand the tire storage problem in their response area and how they might best interact with the appropriate parties in order to prevent or reduce the risks associated with tire fires. A successful mitigation program enforced at the local level will provide a basis for safer tire storage in the community.

Introduction

Tire fires, especially those in which a large number of tires are involved, are very difficult to extinguish. This applies to scrap tire fires, or to warehouse fires that contain large quantities of unused tires. These fires can be dangerous to the health and safety of firefighters and other emergency responders, and to the health and safety of the surrounding community. Tire fires occur throughout the United States, and firefighters are experiencing similar difficulties operating at these fires. Scrap tire fires can occur both in densely populated urban areas and in sparsely populated areas throughout the United States.

While developing this Report to Congress, the USFA investigated many of the issues related to the incidence of tire fires in the United States. This investigation relates closely to Congress's interest in tire fires as indicated in the Fire Administration Authorization Act of 1997. The report being produced as a result of the USFA's investigation, *Scrap and Shredded Tire Fires* (hereinafter referred to as *Special Report 93*) is near completion. *Special Report 93* will become one in a series of *Special Reports* developed by the USFA which focuses on emergency response issues that have an impact nationally, and for which lessons learned are shared with the emergency response community. *Special Report 93* covers such issues as sources and use of scrap and shredded tires, tire fire incident case studies, planning for tire fire prevention and extinguishment, firefighting strategy and tactics, environmental hazard containment, operational safety, cost of tire fires, and lessons learned.

Additionally, the International Association of Fire Chiefs (IAFC) and The Scrap Tire Management Council (STMC) worked cooperatively to develop and produce *Guidelines for the Prevention and Management of Scrap Tire Fires* (hereinafter referred to as The *Guidelines* Report), an overview of scrap tire fire issues that have similar impact nationally. This report was developed with the cooperation of participants from the fire service, government, and industry. In acknowledging their assistance, the document states that "The guidelines contained [herein] are based upon the collective experiences of Incident Commanders [ICs] who have managed major scrap tire fires and are presented as an adjunct to the strategic and tactical practices already part of proper fireground management." The *Guidelines* Report addresses such scrap tire fire issues common to communities throughout the United States as prefire plans, fire prevention, sizeup,

establishing control, health and safety, suppression tactics, environmental concerns, and public relations and information.

In 1990, the Environmental Protection Agency (EPA) estimated that 242 million tires are generated each year, and 75 percent of them are added to existing stockpiled dumps or discarded in landfills. The ever-increasing number of discarded tires poses serious problems, not only in land use, but also in fire and environmental protection. Expressed as tonnage, the EPA has estimated that there were about 3,060,000 tons of rubber (from auto and truck tires) generated in 1995. Of this, only about 17 percent were expected to be recovered, leaving about 2,530,000 tons to be discarded. These figures do not include rubber that is recovered and used for commerce:

> In years past, tires commonly were buried in landfills, a practice that continues in some States. Tires are not desirable landfill material because tire casings trap air, and buried tires often move, interfering with future landfill reclamation. The diminishing permitted landfill space is needed for more suitable trash.
>
> Scrap-tire stockpiles, whether in tire dumps or in piles intended for recycling, create fire protection challenges for fire departments. Tires burn with a higher per-pound output than coal; the high heat production of tire rubber makes extinguishment difficult. Moreover, tire fires yield large amounts of oil that are both flammable and a threat to the environment. Tire fires become hazardous materials incidents that affect entire communities, often requiring neighborhood evacuations and protracted fire operations, and causing contamination of the air, waterways, and water table. (*Special Report 93*, p. 5)

A major fire department objective should focus on controlling the size of tire storage areas before they become so large that a fire would be difficult to extinguish or control. The local authority can play a significant role in providing the enforcement necessary to control the tire storage problem. Codes can have very specific requirements that apply to waste tire storage areas. A New England Fire Chief, in a research paper submitted to the National Fire Academy (NFA) as

part of the Executive Fire Officer Program (EFOP), also documented the need for prevention of, and prefire planning for, tire fires. The Chief, after conducting a small survey of communities that had experienced tire fires, determined that "the primary concern was avoidance of such a situation and thus elimination of the problem." (Obier, p. 1) In his research paper recommendations, the Chief proposed that "the community needs to work together to prevent a fire from becoming large in nature and contaminating the atmosphere." He stated further that "there is a need to separate these tires into manageable areas." (Obier, p. 13) The chief had described a particular storage site in his community "which measures 1,054,152 square feet. Inside this area are 41.555 acres of water and the tires are pushed into the water for disposal. There are at the present time some 20 million tires at this facility. There have been fires in the local area that could have devastated the area had they gotten into this tire salvage." (Obier, p. 6)

Just as there are indicators of potential arson problems or locations, there also are warning signs of future tire pile fires. (See p. 7, Table 1, of *Special Report 93*). According to data gathered by the IAFC and corroborated with case studies presented in *Special Report 93*, a significant number of tire fires occur when fire code enforcement is initiated because owners realize that expenses will be incurred to bring their facilities into compliance. In some cases, they may decide that a fire is a cheaper alternative. A key warning sign is the business shutting down its recycling operation, followed by owner bankruptcy. A fire typically occurs when the property owner or local government attempts to recoup legal reimbursement for disposal of the abandoned tires or tire product, or when a community attempts to have a performance bond required of a facility to ensure that it operates with appropriate financial responsibility.

Table 1

Warning Indicators for Future Tire Pile Fires

- The tire operation changes from tire recycling to scrap-tire storage.
- The operation began as a non-code-compliant facility.
- The State tire fire fee disposal program is not invoiced, and therefore is not audited to ensure proper tire disposal and ethical operations.
- The business owner resists compliance with codes and with fire safety practices.

- Business ownership changes.
- The business owner files for bankruptcy.
- The property owner and/or government pursue(s) court actions against the tire operations.

Fire departments generally extinguish serious tire fires with difficulty. To reduce the risk and challenges to a local fire department, control measures must be taken to prevent what could be a local disaster. The local governing body must take steps to prevent or control the problem. The most beneficial aspect of any training focus would be on mitigation of the problem in conjunction with operational, tactical, and extinguishment methods. In addition, emergency response assessments of tire storage sites should be forwarded to cognizant enforcement or regulatory authorities as necessary. Fire department cooperation and interaction with other agencies, private and public, are essential for efficient response to these fires. As an example, one of the agencies with which the fire service can expect to share parallel interests is that of police first responders. Hermann, in an article that appeared in *American Fire Journal*, provides a model of "the new relationship between enforcement and emergency response in the hazardous materials field." (Hermann, p. 14-15) Although he uses hazardous materials transportation incidents as a basis for the model, the interactions described are applicable to tire fires. Hermann describes a continuous circle of related activities involving regulation and response and points out that existing laws and regulations need to be backed up by inspections, enforcement, and prevention activities. If a violation or an incident occurs, an appropriate response must be made. "This leads to mitigation activities during the response, or possible citations or prosecution as a result of enforcement actions. Enforcement, statistical results, and incident critiques yield useful information that can be used as feedback to produce laws or re-promulgation." (Hermann, p.15) The fire service has practiced mitigation successfully at the local level for many years, and has learned that when enforcement activities become a cooperative effort among agencies, mitigation can be even more successful. Hermann notes that health and environmental quality agencies also have become active participants in hazardous materials scene mitigation. It is during the preplanning phase that the need for cooperative efforts leading to mitigation may be most evident.

Safe tire storage is an essential factor upon which a successful mitigation program may be built. Tire storage programs throughout the United States are diverse, and local fire departments must know what the local and State requirements for scrap tire storage are in their jurisdiction. Knowledge of government legislative and enforcement responsibilities and of the responsibilities of industry are essential to allow fire department personnel to understand the tire storage problem in their response area and how they might best interact with the appropriate parties. Fire departments may find additional information on the subject in *State Scrap Tire Programs: A Quick Look Reference Guide*. (National Center for Environmental Publications and Environment, P.O. Box 42419, Cincinnati, OH 45242-2419. Telephone 800/490-9198. Order Number: EPA530B93001) Another excellent source of information would be their State Department of Environmental Protection or equivalent, and the U.S. EPA Regional Office in their area.

Adherence to, and enforcement of, appropriate codes and regulations will help communities in their mitigation efforts. In the March 1996 issue of *Fire Chief*, author Rodney Slaughter advises that "National standards for the storage of scrap tires have been established by NFPA 231D, Appendix C, and in the *Uniform Fire Code*, Section 11.302(f), but these standards differ greatly from one another when considering tire pile size." Slaughter suggests that "In the case of large existing storage facilities, the minimum requirements should be taken from NFPA 231D, *Standard for Storage of Rubber Tires*, Appendix C." The standard is liberal with regard to pile size, but also calls for "an increase in separation of distances between piles and other exposures."

Fire departments should consider incorporating material relating to tire fire incidents, as it does other hazardous materials incidents, into their training programs. The unique characteristics of tire fires will call for special considerations in developing and delivering the requisite training; however, a basic approach that incorporates common and proven hazardous materials incident strategies should be effective. NFA courses identified in this report would be helpful for fire department managers who need a basic understanding of those technical and managerial skills necessary for managing these kinds of incidents.

An effective mitigation program could be the key to eliminating and/or lessening the impact of tire fires successfully. Mitigation has been practiced successfully by the fire service as part of

departmental responsibilities and initiatives. The *Guidelines* Report captured the essential aspects of what a good mitigation program might include. Prefire planning and fire prevention are core aspects of a fire department plan that would help to mitigate the effects of tire fires in the community. Prefire planning should allow fire departments to determine whether local tire fire storage is safe and meets relevant code requirements. Fire departments then can initiate actions based upon their assessment of the storage conditions and, where appropriate codes and/or legislation are not evident, work with the appropriate authorities and organizations to develop safe storage criteria. As noted, the fire service has a long history of successful mitigation at the local level and tire storage problems can be handled in much the same fashion as other hazardous materials situations. Sizeup, establishing control, health and safety issues, suppression tactics, environmental concerns, and public relations and information, some of which are response based, also are related to planning and prevention activities. Environmental concerns should be included in a mitigation program, e.g., if a scrap tire pile burns, how will the runoff be handled? While responders will need to address this environmental concern as they manage the fire, the fire department's plan should have taken environmental issues into account. Although mitigation is a relatively new term to the fire service, it describes much of what fire departments do, and have always done, to reduce the impact of unwanted fire effectively.

Although one tire fire is not a national disaster per se, such fires, in the aggregate, do have an impact nationally on firefighters and communities. Large tire fires are reported by the media nationally and sometimes internationally.

Tire Fires: A Report to Congress covers specific critical issues related to fighting tire fires in the United States, including risks to firefighters, exposure to toxic substances, the duration of these fires, personal protection, site hazards, and training needs. Other important issues that must be considered by fire departments in planning for, responding to, and operating at these incidents are not the subject of this report, but are addressed in the USFA's *Special Report 93*, the IAFC/STMC *Guidelines* Report, and the various National Fire Protection Association (NFPA) standards mentioned here. Additionally, because the fire department IC may respond to a tire fire that could become a hazardous materials incident, firefighters and other emergency responders must have appropriate protection to work in a hazardous environment. Thus, this report also will

discuss the need for personal protection in fire and hazardous materials environments, as appropriate. Such a differentiation ultimately is determined by the fire department IC charged with directing fire department operations.

This report's primary focus is fire department activities, not necessarily the response or activities of other organizations. References made to the activities of other response organizations are intended to clarify and illustrate issues that are relevant to fire department activities at tire fires. (It is noted in *Special Report 93* that, "After the tire piles are burning, this emergency will most likely meet requirements to involve the state Environmental Protection Agency [or its equivalent] and should be classified as a hazardous materials incident." *Special Report 93*, p. 26)

Sources of information in this *Report* include, but are not limited to:

- The Learning Resource Center (LRC) at the National Emergency Training Center (NETC), Emmitsburg, Maryland, was an important resource for the journal articles and special reports that were reviewed for this report.

- The World Wide Web contained abundant references to tire fire issues, many of which were related to State efforts to mitigate tire fires through appropriate legislation. There also was a significant amount of information from the private sector on issues relating to tire recycling and alternate uses of scrap tires.

- Telephone queries and e-mail were additional sources of tire fire information.

RISKS TO FIREFIGHTERS

The following section examines risks to firefighters who respond to tire fires, looking specifically at suppression hazards, products of combustion, personal protection, fire duration, and site hazards.

Suppression

Tire fires may, at some point, be classified as hazardous materials incidents; when tires are stored, whether legally or not, they are not considered by the EPA to be hazardous waste. Typically, it is when the stored tires become involved in a fire that the fire department and other agencies may be dealing with a hazardous materials incident; in fact, the *Guidelines* Report states that "the scene should be approached and sized up as a hazmat incident." (*Guidelines*, p. 19) Tire fires inherently are difficult to extinguish because of certain characteristics that make them unique:

- size of the fire (which relates to the duration of the fire);
- the inaccessibility of the fire;
- the need for efficient extinguishing media;
- toxic products of combustion;
- geographic, climatic, and/or structural obstacles;
- the need for large volumes of water, interagency cooperation, and preplanning and target hazard assessment;
- personal protective clothing and equipment needs;
- knowledge of the lay of the land and the distribution of the tires;
- rotation of personnel and the need to incept mutual aid; and
- interaction with private sector organizations, such as contractors, and with other government agencies at the local, State, and Federal levels.

These characteristics of tire fires in the aggregate describe a unique set of hazards with which firefighters must contend. This report will discuss specific risks to firefighters which may be related to (a) exposure to toxic products of combustion, (b) personal protection, (c) the duration of the fires, and (d) site hazards associated with those fires.

Products of Combustion

Tire fires produce toxic products of combustion that are considered Immediately Dangerous to Life and Health (IDLH). This requires that firefighters wear personal protective equipment (PPE), including self-contained breathing apparatus (SCBA), to fight the fire or to manage the

hazardous materials incident safely. For these kinds of fires, where the breathing environment is considered IDLH, SCBA (or a pressure demand air line respirator with an escape SCBA) is the only means of respiratory protection that will provide firefighters with a safe level of protection. Also, because these toxic products of combustion almost certainly will contaminate other PPE used by firefighters, all PPE used should be decontaminated to prevent inadvertent exposures after the incident. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and NFPA 471, *Recommended Practice for Responding to Hazardous Materials Incidents* (1997) provide additional information on decontamination of protective clothing and equipment.

The *Guidelines* Report cites an EPA study in which emissions from simulated open burning of tires were examined. "During high burn rates, more than 50 potentially harmful organic compounds can be identified in test burn emissions. Most of the compounds are aliphatically, olefinically, or acetylenically substituted aromatics. Cyclic and chained alkanes, alkenes, dienes, as well as sulfonated, nitrogenated compounds, thiophene, substituted thiophenes, isocynobenzene, and bensodiazine are also identified." This EPA study showed reasonable agreement with compounds that were identified in actual plume samples. "In general, elevated levels of CO particulates, carbon, zinc, benzene, touene, zylene, and polyaromatic hydrocarbons are measured. Polynuclear aromatic hydrocarbons may include napthaline, benzo(a)pyrene, crysene, fluorene, anthracene, and phenanthrene. Metals in plumes consist primarily of lead, iron, and zinc." (*Guidelines*, p. 39)

Guidelines reports that "Studies of tire fires have identified the emission of significant quantities of benzo(a)pyrene, a reported carcinogen, and high emissions of other noxious compounds, particularly benzene (another known carcinogen), with concentrations often exceeding 1 part per million (ppm). (*Guidelines*, p.29)

The *Guidelines* Report also showed that many of the decomposition products associated with tire fires have been characterized in test burns. They include "ash (consisting of carbon, zinc oxide, titanium dioxide, silicon dioxides, etc.), polynuclear aromatic hydrocarbons usually detected in oil runoff (such as benzo(a)pyrene, chrysene, benzo(a)anthracene, etc.), aromatic, napthenic and

parafinic oils, oxides of carbon and nitrogen, particulates, and various hydrocarbons including toluene, zylene, benzene, etc." (*Guidelines*, p. 37.)

The Virginia Department of Environmental Quality (VDEQ) reports that contamination at the Rhinehart tire fire site, located in an agricultural area on the outskirts of Winchester, Virginia, included arsenic, cadmium, lead, zinc, nickel, manganese, polycyclic aromatic hydrocarbons (PAH's), and volatile organic compounds (VOC's). At the site, approximately 5 to 7 million tires eventually were engulfed in the fire. The smoke plume spread across four States, and hot oil flowed from Massey Run to Hogue Creek to the Potomac River. Contamination levels found in the onsite groundwater at Rhinehart are an indicator of the toxicity of the products of combustion. They included "slightly elevated levels of heavy metals, including arsenic, cadmium and lead, as well as volatile organic compounds, including toluene, and xylene. Sediments have been contaminated with oils and residues from the tire fire, in addition to heavy metals such as arsenic, cadmium, lead, and nickel. The soil is contaminated with metals and low levels of polycyclic aromatic hydrocarbons (PAH's) from tire burning." (http//deq.State.va.us./superf/rhine.html)

Personal Protection

The discussion here will focus on the production of polynuclear aromatic hydrocarbons (PAH's) in tire fires in an effort to provide a benchmark for the use of proper protective clothing and equipment. Tire fires may be an even greater hazard to firefighters when they are burning at lower rates, because, as the *Guidelines* Report notes, polyaromatic hydrocarbons predominate at lower burning rates. Polynuclear aromatic hydrocarbons and polyaromatic hydrocarbons are referenced interchangeably in this report; the distinction between them for firefighter exposures and the required PPE is not critical. It is also important to note that proximity to a tire fire may have a direct effect on firefighter exposure. At a small scrap tire fire in Moween, Pennsylvania, in 1993, a positive-pressure ventilation fan "…was used to push smoke into an uninhabited area, away from firefighters." This allowed the foamline crew and members with pike poles who were working at the perimeter of the fire pulling tires out of the pile to operate without SCBA, reducing physical stress to a degree and improving visibility." (Clark, p. 73)

It is essential to note again that the toxicity of tire fires mandates the use of SCBA unless Fireground Commanders can ensure that firefighters are not exposed to IDLH environments. The National Institute for Occupational Safety and Health (NIOSH) investigated the health hazards to which contract workers may have been exposed while working at the Rhinehart fire. The NIOSH recommendations, made while this fire was still burning, stated that, "The smoke plume from the fire contains hazardous substances which should not be inhaled (carbon monoxide, PAH's) or allowed to contact the skin (PAH's). If it is necessary for persons to work in the plume, then they should be provided with air-supplied respiratory protection and skin protection (Level B). While one could argue that there were other sources of PAH's, the actual contribution to the total PAH exposure is unknown. It is a conservative measure to assume that the fire is the sole source until more information is available."

Although this NIOSH report addressed the exposures of contract workers, it is a good source of information for firefighters who must operate at fires at a time when toxic products of combustion may be at their highest concentrations.

The *Guidelines* Report states that "personal protective clothing (turnout gear) and self-contained breathing apparatus (SCBA) meeting NFPA standards should be worn by all personnel working in or exposed to the products of combustion. All non-fire department personnel similarly exposed to the products of combustion should be provided with turnout gear and SCBA, and the appropriate training to use that gear." Local fire departments should be using PPE that meets the requirements of the relevant NFPA standards. Although turnout gear is recommended here, it is important to note that, although it commonly is worn during the initial response to fires and hazardous materials incidents, it may not be the appropriate PPE for tire fires. The NFPA standards provide excellent guidance on the selection and use of PPE.

As was stated earlier, the common products of combustion found at scrap tire fires, in the concentration and volume suggested by the fire service and other experts who have contributed to the literature, must be considered IDLH. This is further highlighted by specific reference to the mandatory use of SCBA in the literature and in the law. Such atmospheres require that emergency responders (e.g., firefighters, emergency medical services personnel, and police), in fact, any

worker expected to work in close proximity to tire fire products of combustion, must wear SCBA. Firefighters often encounter IDLH atmospheres and use SCBA routinely. A brief discussion of the use of SCBA for IDLH exposures underlines the importance of toxic products of combustion as a major risk to firefighters.

On Thursday, January 6, 1998, the Occupational Safety and Health Administration (OSHA) issued the Final Rule for Respiratory Protection. This update of OSHA's existing rule is referred to here for its timeliness. The new respirator standard refers to other NFPA standards with which firefighters and other emergency responders should be familiar. In addition to some of the NFPA standards identified in the respirator standard, other standards with which emergency responders should familiarize themselves include the current or enforced editions of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, NFPA 1404, *Standard for a Fire Department Self-Contained Breathing Apparatus Program*, NFPA 472, *Standard for Professional Competence of Responders to Hazardous Material Incidents*, and NPFA 471, *Recommended Practice for Responding to Hazardous Materials Incidents*. These and other NFPA standards and relevant OSHA regulations provide emergency responders with the essential baseline information required for correct response to incidents such as tire fires.

The NFPA SCBA standard refers to NIOSH-certified SCBA, and also requires additional performance criteria not required in the OSHA rule. For administrative reasons, OSHA is not incorporating the NFPA SCBA performance criteria into the new rule; however, progressive and prudent fire departments will continue to refer to the NFPA standard when procuring and using SCBA for fireground use and hazardous materials incidents.

When questioned about the consistency of OSHA's reference to SCBA among other relevant OSHA standards, the Agency, in the newly published rule, responded that "OSHA has reviewed the definition of IDLH used in its standards and believes that the final standard's definition is largely consistent with those in the two OSHA safety standards that use the term: 29 CFR 1910.146, the Permit-Required Confined Space standard ("Confined Spaces standard") and 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER). (FR1185)

The need for SCBA during operations that are deemed IDLH should be evident to emergency response professionals through training and experience. The NFPA performance-based standard for SCBA more closely relates to the fireground environment and is considered by the fire service to be the safest minimum standard for use on the fireground. The NFPA standards commonly are cross-referenced among themselves and in fire department operating guidelines and procedures. It should be noted that HAZWOPER is enforced by OSHA (OSHA 29 CFR 1910.120) and in those jurisdictions where it does not have enforcement powers, the EPA enforces an equivalent rule.

The new OSHA respirator rule does not refer to specific IDLH values nor does it rely on any particular list. OSHA noted that "it is aware that published IDLH values are not available for many industrial contaminants and that employers therefore must rely on their own knowledge and judgment, and that of safety and health professionals, when deciding that a given atmosphere has the potential to cause health effects of the kind envisioned by OSHA's IDLH definition." It is this knowledge and experience of fire service professionals that allow them to consider tire fire environments IDLH and to require firefighters who are at risk to wear SCBA. The new rule defines IDLH as "an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere."

OSHA has indicated that the new respirator standard reflects current respirator technology and better ways to ensure that respirators fit. The revised standard also clarifies responsibility for administering a respirator program and its provisions, and adds definitions and provides specific guidance on respirator selection, use, hazard evaluation, medical evaluations, fit testing, and training. Further, the changes also will simplify respirator requirements by deleting duplicated provisions in OSHA standards to make all of them consistent.

This new rule became effective April 8, 1998, for the States and Territories, including Alaska, Arizona, California, Connecticut, New York, Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming which have their own OSHA-approved State and Territorial plans. They must adopt a standard comparable to the

new Federal OSHA standard by October 8, 1998. Connecticut and New York, whose plans cover public employees only, also must adopt a comparable standard. This comparable standard applies to State and local government firefighters in the 25 States that operate OSHA-approved State plans through the adoption of an identical or "at least as effective" standard. Federal OSHA has no jurisdiction over such workers, but it does have jurisdiction over Federal employees who fight fires and private-sector employees who fight fires (e.g., members of industrial fire brigades). (The new rule may be best known to firefighters because it includes the "two-in/two-out" requirement that at least two firefighters must enter a fire and remain in visual and voice contact with each other at all times and that two firefighters must be on standby if two firefighters are engaged in interior structural firefighting.) In a joint publication produced by the International Association of Firefighters (IAFF) and the IAFC a summary of the new OSHA respirator rule and how it would affect fire department operations was provided. (29 CFR 1910.120(q)(3)(vi) This document is referenced hereinafter as the "*Summary*."

The *Summary* further advised that, "A number of other states have adopted, by reference, federal OSHA regulations for public employee fire fighters. These states include Florida, Illinois and Oklahoma. In these states, the regulations carry the force of law." (*Summary*, p. 2)

The *Summary* also clarifies coverage of volunteers under the new rule by stating that "the federal OSHA standard applies to all private sector workers engaged in fire fighting activities through the industrial fire brigades, private incorporated fire companies (including the "employees" of incorporated volunteer companies and private fire departments contracting to public jurisdictions) and federal fire fighters." (*Summary*, p.2)

For guidance on how the regulations affect firefighters who enter a hazardous environment that is **not** an interior structural fire, the *Summary* referred to the HAZWOPER, advising that "Fire Fighters must adhere to the two-in/two-out regulations for other emergency response operations in any IDLH, potential IDLH, or unknown atmosphere. OSHA permits one standby person **only** in those IDLH environments in fixed workplaces, not fire emergency situations. Such sites, in normal operating conditions, contain only hazards that are known, well characterized, and well controlled. (*Summary*, p.6) Because specific tire fires generally do not contain only hazards that are "well

known, well characterized, and well controlled," they must be considered IDLH. In tire fires, whether structural or exterior, the two-in/two-out rule applies.

Large tire fires are fought, sometimes under adverse climatic conditions, while wearing full protective clothing and equipment. Such equipment may include turnout coats and trousers, boots, gloves, helmets, and SCBA. While wearing this protective clothing, firefighters can expect to work with handtools, power tools, charged hoselines, and heavy machinery, and to operate emergency response vehicles under very difficult conditions. Such extreme working conditions can result in life-threatening physiological responses in firefighters. The hazards of the products of combustion are so severe that SCBA may need to be worn even while operating emergency response vehicles in the contaminated atmosphere. All of this protective clothing and equipment should meet the requirements of NFPA standards on protective clothing and equipment. In addition, all protective clothing and equipment must be decontaminated appropriately.

The protective clothing and equipment used by firefighters may be similar, but not identical to, the protective clothing and equipment worn or used by other responders at the scene of a tire fire. These workers may be wearing protective clothing and equipment that is classified according to EPA Levels A, B, C, or D. This is a critical distinction, and the casual observer should not infer automatically that different levels of protection are being provided for the same exposure(s). The EPA levels of protection, A, B, C, and D, are not intended for firefighters; NFPA levels of protection (A, B, C, and D) are.

NFPA 471, *Recommended Practice for Responding to Hazardous Materials Incidents*, provides recommendations on PPE for use at hazardous materials incidents. This standard relates hazards to the levels of protection recommended. NFPA Levels A and B require the use of SCBA (or airline respirator with escape SCBA) and are the highest levels of respiratory protection. Level B includes the use of SCBA with "hooded, chemical-resistant clothing" that meets the requirements of NFPA 1992, *Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies* (overalls and long-sleeved jacket, coveralls, one- or two-piece chemical suit, disposable chemical-resistant overalls); it also references foot, hand, and head protection, and two-way radios and face shields (optional). Level B protection could be a choice for those firefighters who are operating in

an area of a tire fire that does not exceed the protection afforded by that level. Ultimately, it is the IC who must decide what PPE is appropriate for each hazardous materials incident. NFPA 471 advises that each of these levels may be used "as appropriate." Because tire fires ultimately may be designated as hazardous materials incidents, and because there is a likelihood of exposures to toxic products of combustion, emergency response personnel must be protected in accordance with the appropriate level of protection under NFPA 471.

Section A-5-6 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, advises that "Fire fighters must realize that no single combination of protective equipment and clothing is capable of protecting them against all hazards. Therefore, chemical-protective clothing should be used in conjunction with other protective methods. The use of such clothing can itself create significant wearer hazards, such as heat stress, and physical and psychological stress, as well as impaired vision, mobility, and communications. In general, the greater the level of chemical clothing protection, the greater the associated risks. For any given situation, equipment and clothing should be selected that provide an adequate level of protection and the ability to carry out emergency response activities. Overprotection as well as underprotection can be hazardous and should be avoided." These wearer hazards referred to in NFPA 1500 are recognized hazards that can have a negative impact on firefighters operating at tire fires.

A comparison of the EPA definitions of Levels A, B, C, and D to NFPA PPE standards will indicate that the EPA levels describe protective clothing and equipment in terms of their configuration and are less performance based than the relevant NFPA protective clothing and equipment standards. The NFPA further advises in the Appendix to NFPA 1500 that these levels of protection "are commonly and often inappropriately utilized by the fire service." (NFPA 1500, 1997 ed. A-5-6, Appendix A)

"The approach to selecting personal protective clothing and equipment must encompass an 'ensemble' of clothing and equipment items that are easily integrated to provide both an appropriate level of protection and the ability to carry out emergency response activities." (1500 Appendix, A-5-6) The tire fire is just the kind of hazardous materials incident that requires skillful fire department interpretation of the tasks and protective measures to be undertaken to assure full

protection for the emergency responder. The IC is confronted not only with a fire but also with toxic products of combustion that present respiratory and skin exposures to the emergency responders. Decisions about whether or not the fire actually will be fought, or, if it is, how it will be fought, factor into decisions on the use of PPE. The IC will need to be aware of all relevant hazards as he or she considers the PPE necessary to adequately protect the response force.

Whether or not to wear structural firefighting protective clothing to incidents for which that clothing has not been certified as being appropriate (by an NFPA standard) can be a difficult decision. In fact, it may, by default, not be a decision at all. The protective clothing that is ideal for a given hazard might not be available to the fire department, leaving firefighters exposed to risks for which they might not be adequately protected. The issue of appropriate PPE surfaced recently in an exchange of comment in the *Forum* section of the April 1998 issue of *Firehouse*. The dialogue concerned a photo depicting firefighters "wearing structural firefighting turnout gear while working a wildfire." (p.6) The author of a prior column, which featured the photo, replied to the writer of a letter who took exception to the picture, stating that heat stress was a major issue in these kinds of fires, and suggested that "…the appropriate PPE be used in order to reinforce the message to firefighters of the high risk of heat stress from wildfire operations." (p. 6) The author's reply stated that the picture was published to depict certain phenomena associated with wildland fires. He stated further that the writer's observation was correct and that "Your commentary on the use of correct turnouts and other health and safety issues depicted in fire service journals is not the first and surely will not be the last. However, your points are well made and correct." The author affirmed his and the journal's efforts to portray safe firefighting practices and advised that "It is my personal desire that all structural fire departments that do respond to wildland fires will eventually be cross-trained, cross-equipped, and that their firefighters will be wearing wildland turnouts. Once this is accomplished, the incidence of heat-related injuries and death could be reduced substantially." (p. 8) The selection and use of appropriate PPE at tire fires is no less important.

On November 2, 1983, NIOSH was requested by the EPA to provide immediate technical assistance in evaluating site safety and worker exposure to unknown and potentially hazardous substances from an automobile and truck tire fire in Winchester, Virginia. As a result, NIOSH industrial hygienists visited the site of the tire fire, reviewed the site safety protocol that was

established by the EPA's Office of Emergency and Remedial Response, and collected air samples. The types and magnitude of contaminants present during the fire containment and preliminary cleanup operations then were investigated. This study focused on possible exposures to contaminants as a function of worker proximity to the fire. Although this workplace focused on the exposures of nonemergency responders who were involved in containment and preliminary cleanup operations, the exposures to those who might be working in the area closest to the actual fire, the Exclusion Area (EA), were required to wear "impervious suits with head covering, three-layer glove protection with taped wrist; boot coverings with taped ankles, [and] supplied air breathing apparatus (EPA Level B)." (Rhinehart Tire Fire, p.3) Workers leaving the EA were decontaminated thoroughly at the scene; some of the personal protective clothing was discarded, and some reusable articles were recycled after decontamination and disinfection. (Rhinehart, p.3) It is important to note here that the described level of protection, EPA Level B, is not directly comparable to the level of protection indicated by the NFPA standards on protective clothing and equipment used by firefighters. As noted, however, NFPA standards generally refer to performance criteria when referencing protective clothing and equipment. As stated above, NFPA standards are the standards to which most local fire departments refer when purchasing PPE. The EPA Level B protection, although appropriate for some contract workers, is not equivalent to the Level B protection described in NFPA 471, an important distinction.

The NIOSH investigation provided recommendations for two conditions, the first of which was defined as that which exists when the fire is still burning. (This is when firefighters may be expected to be at the scene.) NIOSH's report stated that it is a conservative measure to assume that the fire is the sole source of PAH's and carbon monoxide. Air line respirators were recommended for the workers. Although not mentioned specifically in this investigation, firefighters would be required to wear the most protective respirator--the SCBA or an air line respirator with an escape SCBA—if they were to work proximate to the burning tire fire—a very perilous place to be. This is consistent with both the recommendations in the *Guidelines* Report that firefighters use SCBA and with the new OSHA Final Rule for Respiratory Protection.

At a large tire fire in Weld County, Colorado (a 4-day-long operation at a 20-acre tire depository containing some 6 million tires), all personnel within 150 feet of the fire were required

to wear breathing apparatus or appropriate respiratory protection and were required to rotate duty periods with periods of rest in order to avoid exhaustion and heat stress. The USFA's sample Standard Operating Procedure (SOP), *Emergency Incident Rehabilitation* (FA-114, July 1992), and NFPA 1500 provide additional information on rehabilitation. *Emergency Incident Rehabilitation* states that:

> The physical and mental demands associated with firefighting and other emergency operations, coupled with the environmental dangers of extreme heat and humidity or extreme cold, create conditions that can have an adverse impact upon the safety and health of the individual emergency responder. Members who are not provided adequate rest and rehydration during emergency operations or training exercises are at increased risk for illness or injury, and may jeopardize the safety of others on the incident scene. When emergency responders become fatigued, their ability to operate safely is impaired. As a result, their reaction time is reduced and their ability to make critical decisions diminishes. Rehabilitation is an essential element on the incident scene to prevent more serious conditions, such as heat exhaustion or heat stroke, from occurring.
>
> The need for emergency incident rehabilitation is cited in several national standards. Recent studies have indicated that a properly implemented fireground rehabilitation program will result in fewer accidents and injuries to firefighters. Moreover, responders who are given prompt and adequate time to rest and rehydrate may safely re-enter the operational scene, which may reduce the requirement for additional staffing at an incident.

Fire Duration

The duration of tire fires can be significant compared to the fires that firefighters typically extinguish every day. It is axiomatic that larger fires tend to be fires of longer duration. At times, tire fires can require the attention of the entire department, and mutual aid often is called in to provide additional resources and backup to the department. The duration of a fire also can call for greater-than-normal demands on the fire department's customary water supply, causing that supply

to be inadequate. The health and safety of the fire crews also may be affected; there is a direct relationship between the duration of a fire and the amount of toxic products of combustion produced. Crews must be provided with appropriate relief and/or backup; rotation of personnel becomes more and more important at these large-scale incidents.

The duration of a fire also can have an overall devastating effect on a locality's resources. In Buffalo, New York, after a difficult used tire warehouse fire, the fire commissioner requested that the city ordinance on used tire storage be expedited. Six months before this difficult fire was fought, there were 15 other major used tire fires in the City of Buffalo. The commissioner was quoted as saying, "These fires are draining the manpower and equipment of the fire department and also the finances of the city because these kinds of fires are very costly to fight." (*Firehouse*, p. 62)

Firefighter safety and health is affected directly by the fire department's ability to extinguish the fire efficiently and/or manage the hazardous materials incident. The longer the fire department operates at the scene of an incident, the greater the risk to the firefighters. The ability of fire extinguishing agents to extinguish these fires depends somewhat on the size of the fire. In the case of tire fires, the selection of appropriate extinguishing agents is dependent upon the stage and size of the fire, and the choice of agent can directly affect the duration of the fire and the attendant hazards to emergency responders. *Special Report 93* states that, for the tire fires analyzed in it, "In all the cases where extinguishment used water successfully, the tactics employed used excavation equipment to first pull the burning material into small manageable piles. The fire was doused with hand-lines and a front-end loader was used to complete overhaul by moving the material to be submerged or buried until cool." *Special Report 93* also notes that the use of Class B foams on tires is unsuccessful for three reasons. "First, tires are a class A fuel and not extinguished by placing a foam layer between the fuel (tire) and oxygen (air) as is done with flammable liquids. With tire fires, it is not possible to separate the oxygen from the burning tire because the fire will continue to burn under the foam layer. Second, the tire casing is formed with a built-in void space, which provides pockets of air to feed the fire. Thermal updrafts also can cause burning tire piles to draw air from within the pile. Whole tires create natural horizontal and vertical voids, which act as air vents to the burning material. Third, foam is not useful on tire fires because run-off drains out of the pile below the flame and fire heat level. Run-off oil ignition occurs when the tire pile is

disturbed and burning material falls to the lowest level, causing a flare-up. Although generally ineffective for extinguishing tires, class B foam is important to use on run-off fires. A class B foam layer should be maintained over the containment oil pond." *Special Report 93* addresses the effectiveness of Class A foams on tire fires with a cautious note: "There is controversy over whether Class A foams and wetting agents are useful on tire fires. On one hand, experiments with Class A foams by members of the Phoenix Fire Department suggested that the Class A foams provide a definite advantage, especially in deep-seated fires in wood or tires. On the other hand, Class A agents may have to be used earlier in the course of the fire than is commonly possible with tire fires. The detergents in Class A foams may help extinguish tire fires because the water-detergent moisture stays on the tire long enough to absorb the heat. Moreover, the surfactant properties reduce surface tension and keep water from merely bouncing off tires. Many Class A materials resist absorption of water because of surface tension. Wetting agents reduce surface tension, permitting water to flow and spread uniformly over solid surfaces. In theory, wetting agents improve adhesion of water to surfaces and increase absorptive speed. This allows the water to remain at the burning surface or to be absorbed into the burning fire seat where it can absorb heat and extinguish the fire. Wetting agents and Class A foams appear to have their best effect if used early in tire product fires. Their successful use seems to depend on delivery when the fire is in the ignition and propagation stages.

Thus the factor limiting the effectiveness of wetting agents and Class A foams is having sufficient quantities available to use during the ignition and propagation phase of the fire and to start application then. Unfortunately, early application is often not practical because extinguishment could not begin until unburned tires are separated from burning tires and the pile fire is contained with berms. By the time those tasks are completed, the tire fire usually has reached an advanced stage. When used, Class A foams change the capability of the fog nozzle by reducing stream reach, velocity, and spray coarseness. Compressed air systems may overcome the negative effects of Class A foams on fog nozzles and improve foam delivery reach." (*Special Report 93* p.38)

The *Guidelines* Report states that "The use of wetting agents or foam agents is controversial, but generally considered to be of little immediate value for fighting tire fires. The

costs involved suggest that the use of such additives may be efficient only for exposure control." (*Guidelines*, p. 34) It is important that the fire department carefully evaluates the stage of the tire fire and select the appropriate extinguishing agent for use. It is possible that fire departments might not have access to the extinguishing agent of choice or enough of it to control and/or extinguish the tire fire efficiently.

Special Report 93 states that, "In many cases the only effective means of managing major tire fires is by smothering the burning portions with dirt or fill material. However, even when completely covered, it is estimated that tire fires can continue to smolder deep in the base of the pile for weeks, requiring continued observation and environmental monitoring." (*Special Report 93* p. 34*)*

The report further advises that, "To ensure extinguishment, the burned tire product should be buried in dirt or submerged until cooled below 200°F. Burned tires may be submerged in construction dumpsters filled with water or in a three- to four-foot-deep water pond. Extinguished tire product is submerged in the pond until cool, then loaded into transport trucks with a loader." (*Special Report 93*, p. 39)

In Lincoln, Nebraska, "a fire in a pile of scrap tires measuring 150 feet by 50 feet by 10 feet high required one-half of the fire department's equipment and personnel to control. The overtime expenditure during this incident reduced the department's ability to provide prevention and education programs for the remainder of the year."

The Lincoln fire, although not a small fire, has been surpassed by larger tire fires that placed similar demands on the fire service, State, and other local government service providers. The NIOSH investigation of the Winchester, Virginia, tire fire worker exposures indicated that the fire began on October 31, 1983, as a fire of unknown origin in a dump containing approximately 5 million tires. It covered a 4-acre site and produced a black smoke plume approximately 3,000 feet high and 30 to 50 miles long. Ultimately, it was estimated that this fire consumed 7 to 9 million tires before it burned itself out on July 14, 1984. At the time, the EPA determined that "the only way to extinguish the Virginia fire was to remove and douse a few melting tires at a time." Thus,

what were initial conservative estimates nearly doubled after the event ended. This fire burned for nearly eight and one-half months, underscoring that tire fires easily can overcome the resources of local fire departments. (Where *The New York Times* reported that 7 to 9 million tires were consumed before the fire was extinguished, the Virginia Department of Environmental Quality (VDEQ) determined that there may have been 5 to 7 million tires involved.)

Several other tire fires in the U. S. during the period from 1995 to 1997 give further evidence of the long duration of tire fires: (*Special Report 93*, p. 20)

- Falling Spring Road, Garfield County, Washington, February 16, 1996
  This fire, which started in February and was extinguished in June, required five months of "digging out."
- Washington, Pennsylvania, February 28, 1997
  14 days; 500 residents evacuated; 20 schools closed.
- Chautauqua County, New York, April 23, 1995
  9 days; 50 residences and one school evacuated
- Frankfort, Kentucky, August 15, 1995
  4 days
- District of Columbia, December 8, 1995
  3 days
- Gila River Reservation, Arizona, August 7, 1997
  7 days

Site Hazards

The products of combustion from tire fires are considered toxic and operations at the site of a tire fire must be undertaken with great care for the safety and health of firefighters. Products of combustion may be found in breathing air at some distance from the source of the fire. Past tire fires have required that residents in the surrounding areas be evacuated, and fire departments may need to plan for such evacuations.

The site presents thermal hazards to anyone operating proximate to the fire. Thermal hazards require appropriate protective clothing and equipment to be used by personnel operating at the scene. Thermal hazards will be primarily radiated and convected heat; direct flame contact (conducted heat) should be less of a threat.

One of the most serious, and perhaps most pronounced risks to the environment, is the threat posed by run-off tire breakdown during the combustion process. "For every million tires consumed by fire, about 55,000 gallons of run-off are produced. The average passenger car tire is estimated to produce about two gallons of oil. Tire fire run-off is a significant environmental pollutant that can get into groundwater and contaminate well water. In addition to run-off, more than 32 toxic gases are produced by tire fires." (*Special Report 93*, p. 9) This environmental risk increases when fire departments use solid streams "which tend to spray off the tires without reducing the surface temperatures, and cause increased run-off while depleting water supplies more quickly." (*Guidelines*, p. 34)

The *Guidelines* Report also notes that mosquitoes, rodents, and snakes may be found in piles of tires. (*Guidelines*, p. 32) The Pennsylvania Department of Environmental Protection reports that "Along with their potential as fire hazards, tire stockpiles also provide an ideal breeding ground for mosquitoes."

Regardless of their position, tires can fill partially with water and, because they absorb sunlight, they provide an ideal environment for hatched larvae. “Although tire dumps sometimes are associated with rodents, the primary problem has been with various species of disease-carrying mosquitoes that like to breed in tires. In fact, *Culex pipiens* commonly is referred to as the ‘tire pile mosquito.’ Of the many species of mosquitoes that currently breed in Pennsylvania, at least two varieties are important carriers of disease. These mosquitoes, *Aedes triseriatus* and *Culex pipiens*, transmit two strains of encephalitis: La Crosse encephalitis and St. Louis encephalitis. Recently, a third mosquito [the Asian tiger mosquito] has been found to be a cause for concern. This mosquito was introduced to the United States from Asia through shipments of waste tires into Houston, Texas, in 1995. Since then, the mosquito has been transported throughout the United States via waste tire shipments, and has been found as far north as Chicago, Illinois. The

infestation of the Asian tiger mosquito is considered serious because of its ability to transmit several diseases. It is nicknamed for its aggressiveness when biting humans."

Climatic conditions also can have an adverse effect on the ability of firefighters to extinguish a fire. At a January 1988, fire in Berks County, Pennsylvania, firefighters "had to make certain the water kept moving. Left too long, the water froze and became useless. Runoff water did freeze in many small patches around the fireground, making it hard for firefighters to get around on the ice. Newspaper reports say the smoke at that fire was so thick that firefighters could only see the edge of the flames, which made it impossible for them to determine the full extent of the fire from the ground. Dense smoke makes attack operations more difficult and dangerous. Nighttime especially may cause similar problems, especially when it's difficult to gain an accurate set of perspectives on where the fire is burning."

A phenomenon called "black rain" may occur if it rains during a tire fire. Such rain will pick up and deposit products of combustion at the site and beyond. Because this rain contains these contaminants, the *Guidelines* Report recommends that "full turnout clothing be worn by all personnel." (*Guidelines*, p. 30) Of greatest importance here is the avoidance of contact with black rain on the skin. *Special Report 93* also comments on runoff and advises that "…the initial stages of the fire may best be spent planning how to effectively separate unburned tire exposures and how to contain run-off oil. Water is best used to keep unburned tires from burning rather than to extinguish the burning tires." (*Special Report 93,* p. 34) Rain at tire fires then can present a hazard to the fire fighter and also may be considered an environmental threat.

IC's also will need to consider protecting any exposure at the site of the tire fire. This is a basic aspect of fire department response and early consideration of exposures is critical. *Special Report 93* notes that "All of the tire fire case studies examined involved fire exposure problems, and this may be the most important and difficult challenge to address. The exposure priority of burning tire products is usually the unburned tire piles. If the fire can be stopped from spreading to unburned piles, then the fire department has protected the exposure and contained the scope of the incident." (*Special Report 93,* p.33)

Special Report 93 notes that "Mud, deep ruts, and steel wire cords from burned tires can block or damage vehicles. To ensure that vehicles will have a suitable roadway to come and go from the fire site, stone, dirt, and a bulldozer are often needed to maintain site access." (*Special Report 93*, p.24)

The risk to contract or other non-fire department personnel operating at the site include many of the hazards to which firefighters will be subject. If they are working close to the fire, they may be exposed to rapid fire spread and flareup. (*Special Report 93*, p.43) The instability of the piles presents a hazard and heavy equipment should not be driven over them. Additionally, the height of stacked tire piles presents a danger to firefighters working in the vicinity. (*Special Report 93*, p.43)

SUGGESTED TRAINING FOR TIRE FIRES

Training in the Application of the Incident Command System (ICS)

The success of any response to a fire emergency is a preplanned command structure that permits the person in charge (IC) to delegate authority and tasks appropriate to the emergency at hand. This command structure must be both flexible, to allow for expansion and contraction as necessary, and universal, so that if assistance from other agencies is required, all participants are working within the same command structure. Without a common basis for identifying and communicating strategies and tactics, and a system for requesting resources and communicating the accomplishments of assignments, an emergency operation likely will not succeed.

For approximately 20 years, the fire and emergency services have been using a command system called the Incident Command System (ICS). The ICS recognizes the importance of a single command structure; it allows for appropriate delegation, expansion, contraction, and integration of tasks, responsibilities, and outside agencies. In every State and municipality, on every emergency call, the ICS has demonstrated its strength, simplicity, and value.

The NFA has endorsed the ICS as the system for use by the fire and emergency services nationwide. Accordingly, the Academy offers several courses that have the ICS as their basis.

Training in the Extinguishment of Fire Involving Hazardous Materials

Fires involving tires, which are primarily hydrocarbon fires, require special strategies and tactics. There are concerns associated with tire fires that include the threats to first responders, local inhabitants, and the environment cause by exposure to toxic materials and products of combustion. Commanders and responders must protect themselves and others (and the environment to the extent possible) from these toxic threats.

Secondary to those concerns is the actual difficulty of extinguishing tire fires. There is generally a heavy fuel load, as well as ample oxygen to sustain the fire once it begins. These kinds of fires tend to occur in remote areas, and gain considerable headway before being reported. Commanders and their subordinates must develop the kinds of strategies that will address both the toxic and the fire problems presented.

Site Cleanup and Recovery

Threats to people, and threats to the environment do not disappear when the smoke clears and the last ember is extinguished. Tire remnants, as well as the extinguishing agent that was applied, still contain toxic substances. While the immediate problem is resolved, the remaining problems are more long term, and perhaps just as critical. The questions loom: what to do with extinguishing agent runoff, and what to do with the remaining tires?

How Training Can Be Provided by USFA

The USFA's National Fire Academy has a number of courses available, through either its residential training program in Emmitsburg, Maryland, or through its 50 State training partners. While no courses have been developed specifically for tire fires, a number of courses that deal generally with incidents of fires involving hazardous materials can be applied to the problems presented by tire fires:

- *Hazardous Materials Incident Analysis*
- *Incident Command System*
- *Recognizing and Identifying Hazardous Materials*
- *Initial Response to Hazardous Materials: Basic Concepts*

- *Initial Response to Hazardous Materials: Concept Implementation*
- *Incident Safety Officer*
- *Basic Life Support/Hazardous Materials Response*

These courses are available for purchase through the National Technical Information Service (NTIS). They were designed and developed so that local communities can purchase training courses at a nominal cost, and use the curriculum to train their own organizations.

The NFA offers three off-campus courses through its State and local fire training partners. If the State or local agencies administer these courses through either the Superfund Amendments and Reauthorization Act (SARA Title III) or Hazardous Materials Emergency Planning (HMEP) funds, the entire cost of delivery may be supported. (This applies to two- to six-day courses.)

- *The Chemistry of Hazardous Materials*
- *Hazardous Materials Operating Site Practices*
- *Hazardous Materials Incident Management*

The NFA's residential program offers a number of two-week courses which may apply (but are not solely directed towards) tire fires:

- *Command and Control of Fire Department Operations at Target Hazards*
- *Hazardous Materials Operating Site Practices*
- *Hazardous Materials Incident Management*

Any training would be well served to stress the mitigation aspect of the problem in conjunction with operational, tactical, and extinguishment methods. In addition, training and educational effort also should be directed to the local or State governing bodies that have enforcement or regulative responsibilities.

To that end, the NFA has a number of prevention and risk reduction courses available in its residential and off-campus (available either through purchase from the NTIS or through State and local training systems) curriculums:

Available for purchase through the NTIS: (these vary in length)

- *Recognizing and Identifying Hazardous Materials, 2nd ed.*
- *Introduction to Fire Inspection Principles and Practices*

Off-Campus Deliveries through State and local systems: (two- to six- day courses)

- *Methods of Enhancing Safety Education*
- *Community Risk Issues and Prevention Interventions*
- *Fire Inspection Principles*
- *Community Education Leadership*
- *Maximizing Resources and Markets in Community Education*

Residential: (two-week courses)

- *Code Management: A Systems Approach*
- *Management of a Fire Prevention Program*
- *Strategic Analysis of Community Risk Reduction*
- *Fire Inspection Principles*
- *Plans Review for Inspectors*
- *Presenting Effective Public Education Programs*
- *Developing Fire and Life Safety Strategies*
- *Community Education Leadership*

Conclusion

Tire fires, because of their unique hazards, provide firefighters with unusually severe challenges that must be met effectively and safely while operating at such incidents. The NFA has been able to develop and provide training courses that help the local fire service to respond to and safely mitigate the effects of incidents that involve the kinds of hazards found at tire fires.

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