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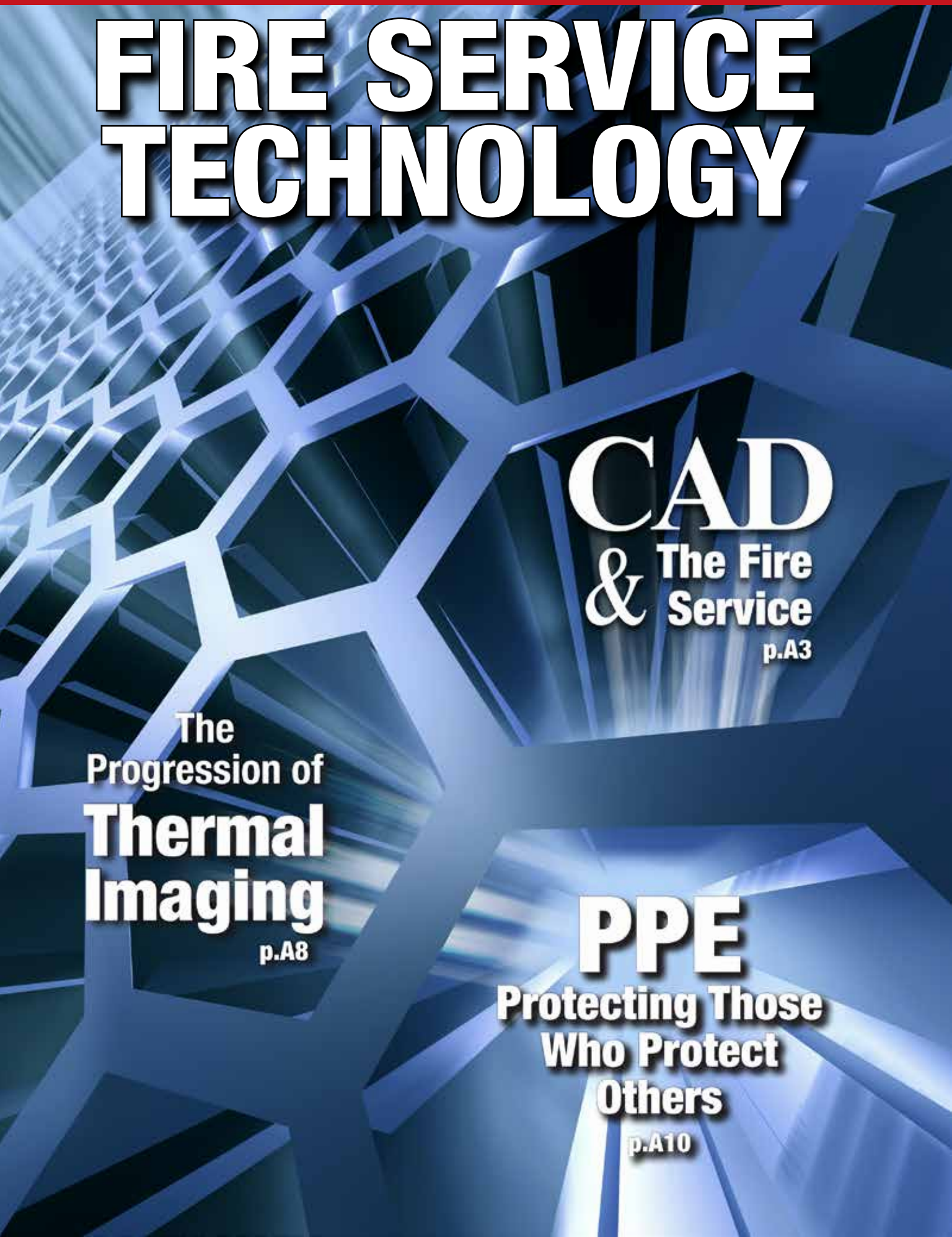

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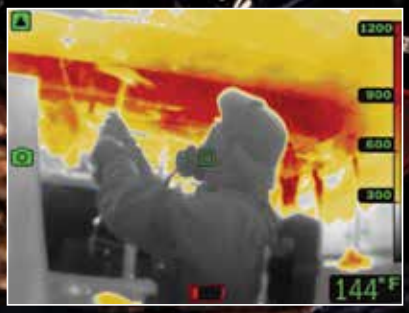

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By Charles Werner

CAD & The Fire Service

Dramatically changing the way 911 calls are received and dispatched

Computer-aided dispatch (CAD), also known as computer-assisted dispatch, is a method of effectively dispatching and tracking emergency service incidents through the assistance of a computer with CAD program software.

With the orthophotography layer, the map displays what one would see in a Google Earth satellite view. This CAD map shows the uncertainty radius of a 911 cell call, which can assist the call taker in identifying the caller's actual location, since the caller is most likely within the circle. *Image courtesy of FDM Software*

CAD originated in the area of law enforcement. For many years, the CAD functionality for the fire service had been limited because the law enforcement dispatching procedures were much different than that of the fire service. Over recent years, the CAD vendors have been actively engaged with public safety organizations like the International Association of Fire Chiefs (IAFC) and the Association of Public Safety Communications Officers International (APCO) to learn more about fire service needs. Presently, CAD systems offer more functionality and value to the fire and EMS service than ever before.

Generally, a call is received through an Enhanced 911 (E911) telephone system, which automatically displays address location and phone number (ALI/ANI) information. This ANI/ALI call information is integrated/interfaced from the E911 and populates this information into the CAD system. A call taker or dispatcher then adds the incident information into CAD. Based on the incident location, location of assets and call type, the CAD system generates a dispatch recommendation. These station/unit recommendations are based on response criteria developed by each locality's emergency service protocols. Once the dispatcher accepts the response recommendation (or makes a change/correction), the CAD will generate selective station/unit tones through an encoder connected to the land mobile radio system. Depending on the CAD, the voice dispatch may be performed by the dispatcher or on newer CAD systems it may be entirely automated through a digital voice rendering over the radio system.

CAD has dramatically changed the way that 911 calls are received and dispatched. The information/data is immediately captured and documented within

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a system database, which includes the phone number, address, call type and call-related times (call received, dispatch time, unit responses, unit arrivals, units in service). Once the information is populated into CAD, CAD may provide station/unit recommendations, recommended response routing, access to online pre-fire plans, automatic vehicle location (AVL) of emergency units, access to hazardous material information and more. Much of this information is automatically populated into or accessed from a fire department records management system (RMS). CAD also provides the quick and easy means of updating unit status and a way to activate other dispatch functions with just a few keystrokes or clicks of a computer mouse. CAD systems that integrate emergency unit AVL are able to make response recommendations based

Questions to Ask When Purchasing a CAD System

- Can fire personnel view and update multiple pieces of critical information from the central map screen, such as unit status, hazardous chemicals onsite, call comments, zones, current weather conditions, cross streets, alternative entrances, Knox Box location, gas shutoff valves, emergency exits, etc.?
- Does the software determine and display the quickest route to a call based on actual drive time, taking into account local street networks and barriers such as rivers, canyons and limited-access highways?
- How efficiently does the CAD product handle multi-agency and multi-jurisdictional dispatching?
- Can agency information be shared (law to fire, fire to law, etc.) easily as approved by the jurisdiction?
- Can firefighters get direct access to dispatch information without utilizing radios?
- Does the view update in real time as dispatchers add new call comments?
- Does the software allow the incident commander and fire personnel to quickly see the real-time location and status of all calls and units via color coding or some other method? Are those codes customizable to meet your own department's needs?
- Can personnel be alerted when pre-determined time limits have lapsed?
- Does the software give fire personnel access to critical premise information, such as contact information, floor plans, alarm locations and hazardous materials – including integration to the full National Oceanic and Atmospheric Administration (NOAA) CAMEO Chemicals system?
- Can the CAD system interface with voice/alphanumeric pagers, smartphones, faxes, printers, tablets, computers, printers and landline phones?
- What mobile (smartphone/tablet) platforms will this program work on (Android, Apple iOS, Blackberry, Windows)?
- Can the CAD system integrate/utilize Pictometry data?
- Does the CAD software provide a "dashboard" feature that provides quick snapshots of incident activity?
- Can the software capture, receive and/or send digital images and video to field units via smartphone, tablet and/or computer?

With the orthophotography layer off, a more typical map view of a location is seen. Here is the same CAD map as page A3 – red dots indicate fire hydrants. *Image courtesy of FDM Software*

on the closest available unit to ensure the best possible response time.

Some of the most important features within CAD are: Quick and easy incident data entry, which includes minimized keystrokes, drag-and-drop dispatching functionality, CAD-to-CAD interface with other jurisdictions, automatic radio log entries, instant search/playback capability, incident status timers/alerts (unit response delay, accountability time intervals, firefighter Mayday situations, incidents that have not been dispatched, premise information, duplicate call notification, etc.).

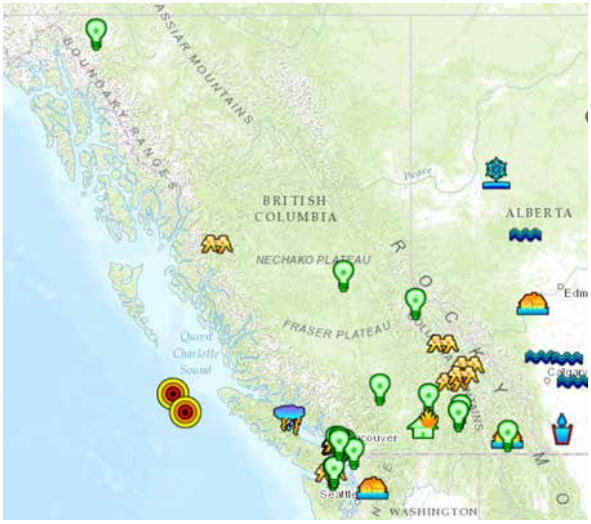
Other important features include:

Silent or messaging dispatch

In addition to voice dispatching, most CAD systems today provide automated text messaging to individuals or groups directly to pagers, smartphones, tablets and email. The information for this text alerting is preloaded into CAD and occurs simultaneously to the identified users and their assigned devices. Often, the text message alert is received more quickly as it is transmitted as data and it does not have the delay of the transmission of selective tones that precede the voice dispatch.

Mobile/apps

Yes, there's an app for that. In our world of smartphones, tablets and computers, there are applications (apps) now available that can interface with the CAD system and provide all of this information instantaneously to a variety of mobile devices. Some of these mobile apps also



Canada-wide MASAS site updated in real time by various stakeholders, including from CAD through FDM CAD-MASAS interface; circles indicate earthquakes; waves indicate flooding; light bulbs indicate power outages. *Image courtesy of FDM Software*

allow direct unit status updates to CAD (in service, responding, on scene, returning to quarters and in quarters). On the mobile devices that have GPS capabilities, the apps can also provide an AVL interface with CAD that automatically updates CAD recommendations of closest unit dispatch. The apps also add the functionality of response route recommendations, access to pre-fire plans, access to hazardous materials data, etc. These features dramatically reduce emergency radio traffic and lessen the workload on the dispatchers. Time saving and effectiveness building features become more important during a significant emergency incident or a large-scale event.

Mapping/Geographic Information System (GIS) interface

CAD systems today also offer either its own mapping solution and/or interfaces with a locality's GIS data layers. This geospatial information is invaluable as it gives a quick look at the number and location of incidents that are currently active and can provide additional information such as online real estate files, etc. This identifies trends such as incident location clusters that may result from a significant incident, a severe weather event, etc. GIS information can also bring in other information such as traffic conditions, damage assessments, power outages, earthquake activity, flooded areas, snowfall amounts and more. AVL information provides a geospatial reference (on a map) to the location of assets and can quickly provide a view of unit utilization and availability. This is crucial to knowing when asset utilization is reaching critical mass to help initiate the request for additional resources from neighboring jurisdictions. AVL is a geospatial function that helps to identify and dispatch the closest unit to the emergency incident.

Interface with other records management systems

CAD systems now have the ability to communicate in a two-way fashion with fire records management systems (fire RMS). This achieves several things. First, CAD can automatically initiate an incident report and populate data on the call type, unit(s) assigned, incident times (call taken, call dispatched, unit responses, unit arrivals and units ready for service) and address. Modules that provide pre-fire plans can access information about the specific occupancy, Knox Box locations, hazardous material locations, location of handicapped occupants and other challenges in the building. This information can also alert incident commanders as to previous responses to this address.

Developing a CAD-to-CAD standard

In public safety systems, standards and standardized data practices are under discussion to allow disparate CAD systems to exchange incident information (CAD-to-CAD interface).

APCO is working on a project called the Unified Computer-Aided Dispatch Functional Requirements (UCADFR) toward the purpose of CAD-to-CAD standards development. The following information is provided from APCO's website (https://www.apcointl.org/resources/unified-cad-project-ucads.html):

"Public safety stakeholder disciplines include emergency communications, law enforcement, fire service, EMS and the CAD provider industry. The UCADFR will be an invalu-

able resource to these communities by supporting the planning, acquisition and management of full-featured CAD software applications. Practitioners writing Requests for Proposals (RFPs) for CAD systems to support multi-service dispatch centers will benefit from the revised CAD functional specifications document."

North America National Information Sharing Initiatives (U.S. & Canada)

In the United States, Mutual Aid Net involves 20 states using a software application that is designed to serve as a resource database and mutual aid deployment tool. The development of Mutual Aid Net was funded by FEMA, and accomplished under contract with the IAFC, which operates the system utilizing several hardened data server sites around the country to provide a highly reliable resource to fire and related emergency services.

In Canada, a similar interoperability project is underway involving the Canadian Safety and Security Program (CSSP). Over the past three years, this project involves a solution called the Multi-Agency Situational Awareness System (MASAS). MASAS connects different departments' systems in a way that allows the exchange of real-time, location-based incident information to public safety responders and emergency managers. More information on this can be found at the following website: http://www.firefightingincanada.com/equipment/interoperable-response-19130#sthash.6gPiIV9j.dpuf

Additionally, the National Information Sharing Consortium is working in collaboration with a joint White House/Department of Homeland Security (DHS) initiative called the Incident Management Information Sharing Consortium Sub Committee. The purpose of this initiative is to engage public safety responders for their input for the purpose of developing a standardized national approach to information sharing environment. This effort is mainly focused on the standardization of data format and folder design.

Wrap up

Computer-aided dispatch is the critical first step to initiate a dispatch/response of emergency resources to an emergency incident and the first phase of information sharing.

A properly designed CAD system will greatly enhance the effective utilization of emergency resources throughout the emergency incident cycle. While a general list of questions for fire service consideration when purchasing a CAD system has been provided, it is highly recommended that this process be inclusive of all the parties (agencies) involved and that a consultant with CAD expertise be utilized to facilitate the development of a comprehensive RFP due to the nature and complexity of this procurement. ■

By John Hays

The Progression of Fire Service Thermal Imagers

Assessing where we have been guides an understanding of the future

Design concept for SCBA thermal imager: C-Thru Smoke Diving Helmet
Photo courtesy of Tuvie

Edward Teller said, "The science of today is the technology of tomorrow." Technology originally developed to help war fighters target opposing forces on the battleground has evolved to become a vital life-saving tool for firefighters.

Looking back on the advancement of thermal imagers (TIs) for the fire service offers more than just a retrospective on technology evolution. It provides insight into the future adaptation of thermal imaging for the 21st-century firefighter. First, though, let's start with the retrospective.

An evolution of usability

Thermal imaging use for fighting fires dates back to the 1970s with use in aerial operations for wildland firefighting. In the 1980s, TIs were deployed sporadically in certain fire departments in the U.S. and Western Europe and more extensively in military, specifically shipboard, firefighting. These products were very large, heavy and suffered substantial performance limitations. As the U.S. military began declassifying newer technology, better, less-expensive systems emerged. By the late 1990s, TIs had adapted to become relatively ergonomic, low-cost devices accessible to fire departments that had the funds to acquire them.

By today's standards, TIs of the 1990s were large, fragile and lacking in capability and features. But as with most technology life cycles, the pace of change has slowed in the last few years. The fire service enjoys a range of handheld thermal selections with most units now weighing three pounds or less and incorporating technology that yields clear imagery in cool, bland scenes as well as high-temperature environments encountered in interior fire attack. Some firefighters now ask if the TI really needs to get any smaller, more powerful or more feature-rich.

While the answer to this question is debatable, there is no denying that thermal imagers continue to evolve. The ability to make the devices even smaller, more integrated and more capable will only increase in the coming years. The question that manufacturers need to answer is: how will they evolve? Handheld TIs have become good enough for most firefighters and practical advancements are not easily determinable. However, those who have used thermal imagers in any number of fire operations, par-

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ticularly interior fire attack, still await a viable hands-free thermal imager.

Early attempts at hands-free firefighting thermal imagers were dreadfully clunky. These units, deployed as helmet-mounted TIs, were large, heavy and generally unwieldy, and they realized limited market success. A refined helmet-mounted TI emerged years later, and although much smaller and lighter, wasn't compelling enough in usability and performance to gain traction. Perhaps even more importantly, the prices charged for all of these hands-free products proved to be a barrier to mass-market adoption.

Once technology prices decline to points that enable deployment on a mass scale, like the deployment of self-contained breathing apparatus (SCBA), and as this technology shrinks in size and weight, the opportunity for the first truly market-penetrating, hands-free products will materialize. We are not there yet.

None of these insights is novel. The notion of hands-free being something of an "end-game" for thermal imagers has existed since before most fire departments even owned TIs. In the 1990s, virtual-reality simulations and military night-vision goggles coaxed many to believe that hands-free TIs would dominate the market long before now. That hasn't happened, but the emergence of an entire category of hands-free thermal imagers in the not-so-distant future is plausible.

While technology progression and declining prices are market drivers, so too is user acceptance. Fire service purchasing decision-makers must "buy-in" to the principle of thermal imaging as an important tool for firefighting use. More firefighters with thermal imagers put more eyes in structure fires. This offers tremendous advantages for personal navigation and safety from hazards such as holes in the floor, ceiling collapses and even flashovers (interpreting the latter requires an advanced understanding of thermal imaging).

More TIs also means increased ability for accountability. Taking this idea further, thermal imagers bolster efficiency since interior firefighters can easily maintain visual awareness of team members operating in multiple areas or even separate rooms. Firefighters using thermal imagers on fire suppression can coordinate hose streams for maximum effectiveness. All in all, more TIs mean a safer, more effective fireground operation.

What happens next?

TIs today are powerful, multi-purpose devices capable of providing a wealth of information to a firefighter. For fire attack, the most beneficial innovation is integrating the thermal imager somewhere on the firefighter. While TIs today are often deployed tethered to gear, they still require handling to use. If designed exceptionally well, TIs that are integral to the firefighter's personal protective equipment (PPE) and do not require handling promise the ultimate in usability and ergonomics. Such devices afford the firefighter to free up his or her hands, which can be used to hold tools, pull hose or otherwise work and operate unencumbered.

Manufacturers must consider how firefighters do their jobs and determine the optimal approach for a hands-free thermal imager. Obvious options are on the helmet or integrated into the SCBA facepiece. Many firefighters assume that thermal imaging technology will ultimately integrate into SCBA, most likely the SCBA facepiece. The facepiece provides a logical place to house an infrared engine and, coupled with advanced display technology, may yield the most seamless heads-up viewing possible. Firefighters would simply look through the SCBA facepiece or off to a side to view a thermal overlay of the scene they are navigating.

Still, there are plenty of constraints on size and space in an SCBA, even with smaller devices emerging, so doing this in a way that doesn't feel forced or cumbersome is not an easy challenge. Additionally, bringing new SCBA products to market is no small task. Product design, engineering and testing take time and achieving NFPA 1981/1982 standard certification is long and difficult.

Another apparent location to house thermal imaging technology is on the helmet. Helmet-mounted models emerged as early as the mid-1990s, but suffered from usability issues. As newer technology develops, TIs could be small enough and light enough to integrate ergonomically into the helmet. For instance, as with previous helmet-mounted TIs, the unit could be housed on the helmet brim with a drop-down display.

The advantages of helmet-mounted TIs are that, like SCBA-mounted units, the image is in the firefighter's normal field of view. Additionally, structural fire helmets are used in just about any fire-related activity and wouldn't necessarily be removed for operations such as investigations or overhaul.

Helmet-mounted TIs do pose weight and balance issues that manufacturers will need to solve. This has proven to be a challenging prospect and one that hampered even newer generations of helmet-mounted TI models. Additional weight on a firefighter's head is felt more readily than on other parts of the body.

The head and face are not the only possible options for a hands-free product, though. Products could conceivably be engineered to interface with hands, arms, shoulders or perhaps elsewhere. Which approaches ultimately prevail will be a function of how users move and operate and how well such approaches interact in this environment. Likewise, shrinking form factors could enable firefighters themselves to innovate how to utilize and stow the TI.

Like with just about any forward-looking assessment, nothing is for certain. The continued progression of thermal imager designs and feature options is predicated on customer demand. Where the customer leads, the market will follow.

It seems clear, though, that thermal imagers of the future will be better, more capable, less-encumbering devices that enable firefighters to navigate to and extinguish fires more quickly and more safely. Rescues will be made easier with features that augment the firefighter's ability to perform various operations in a scene. New designs will enrich usability, whether units are deployed as traditional handheld devices or as integrated, hands-free designs. Prices will continue to drop, and fire departments will help fuel or stall the pace of this decline with their stance on the importance of increased deployment of TIs throughout their operations.

We all have a stake in the future of thermal imaging in the fire service and one thing is for sure: it will be a fascinating journey. ■

By Jim Reidy

PPE: Protecting Those Who Protect Others

NFPA committees to update safety standards

When it comes to personal protective equipment (PPE), who but a firefighter would know best what we need? My friend and mentor, Jim "The Leprechaun" Campbell, always told me, "We wear it, use it and our lives depend on it; (firefighters) should have the ultimate say in what we wear."

Why not? Think of what the equipment was when we came in and what it has evolved into today. I've been on the job 27 years and I marvel at how much the equipment has changed.

Many of those changes have come as a result of National Fire Protection Association (NFPA) 1971 Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting and NFPA 1851 Standard on Selection, Care and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting. These two main standards are not only the firefighter's guide for their protective clothing, but also their assurance that standards and technology will move forward with the times. We are currently at the beginning of the process for the next update of the 1971 Standard, which is targeted for publication in 2018. Public input for this next edition of the standard is open until July 5, 2015. The next edition of NFPA 1851 is due to be published for 2019 and is not open for public input yet.

The largest percentages of people on these committees are current or past users of firefighting PPE. I am a shift fire lieutenant and, as a current user, it never ceases to amaze me how much goes into our equipment standards. As firefighters, we all do evaluations, field tests and spec writing, but the equipment and material testing done before anything gets certified to be produced is detailed and meticulous, to say the least. Many of the tests now used are adapted or brought straight over from other industries or applications. Having said that, many of the end users on the committee are pushing for more firefighter occupational-type testing to mimic what we do, how we do it and in the environment or circumstances it is used. In other words, practice like we play. Why wouldn't we test the equipment and materials under the same conditions in which we operate?

The Stoll Curve

Most everyone knows what TPP is, but do you know how we got there?

Alice Stoll and Maria Chianta conducted burn injury research on "sailors, pigs and rats" in the late 1950s and early 1960s at the Aerospace Medical Research Department, Naval Air Development Center. Sailors of the U.S. Navy volunteered to be burned on their forearms for a weekend pass. Stoll and Chianta used heat exposures on human and animal skin to determine the level of heat energy that would create a second-degree burn. For their work, they defined a second-degree burn as the point at which a blister forms, which is the point at which the outer layer of human skin, the epidermis, is destroyed. The Stoll and Chianta data was presented in a landmark paper in 1969 and was later used to create the "Stoll Curve," which quantifies the level of heat and the duration of time required for a second-degree burn for a wide range of exposure conditions.

Thermal protection

We always talk a great deal about thermal protective performance (TPP) and total heat loss (THL). Do we want to raise the minimums? Is it time for a maximum TPP? After all, the Stoll Curve is based on data presented in 1969 (see box above).

The NFPA minimum TPP for firefighting bunker coats, pants and gloves is 35. The maximum the Stoll Curve measures to is 60. Anything said to be higher than

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60 TPP is a guess, an extrapolation or wishful thinking. THL is another matter. THL is your "breathability." The NFPA minimum for bunker coats and pants is 205 and there really is no maximum. There is, however, normally an inverse relationship between TTP and THL – when one goes up and the other goes down. Another consideration regarding TPP and THL is that we only test swatches of composite materials, not the whole garment. In real-world use, the whole garment has quite a few places of "second layers."

Consider your reflective material, pockets and tabs. While your TPP may be increased in those layer places, your THL will be reduced. Wearing self-contained breathing apparatus (SCBA) is wearing another layer (or more) in certain places. I think our protection from the fire/heat has reached the peak of what is practical and safe. Consider that half of the TPP number is the time to second-degree burn; consider if you had a 60 TPP rated set on and went into a fire until you started to feel the second-degree burn. Imagine how deep in you would be and how long it would take to get out. With the time to flashover coming faster now than ever before, we need to be more cognizant about our gear and how much protection we can realistically expect from it.

Heads up

Helmet retirement always seems to evoke some emotions on behalf of firefighters. The integrity of the helmet can only be tested through destructive tests. Any material the helmet is constructed of degrades with each thermal exposure. Kevlar and fiberglass helmet materials degrade with UV exposure. The improvements of prior standards can be assured to be in the helmet the firefighter is using. As a comparison, the National Athletic Equipment Reconditioners Association reconditions/recertifies approximately 1.7 million athletic helmets yearly and will not recondition/recertify any helmet 10 years of age or older. That 10-year life is determined by the manufacturer's date of initial season of use. Occupational Safety and Health Administration (OSHA) 1910.135(b)(1)(i) and American National Standards Institute (ANSI) statute Z89.1-2009 direct that the longest a hard hat should be in service is four to five years from date of manufacture.

Firefighting helmets have also seemed to have evolved to a point of maximum protection. One concern voiced was over the lack of an internal temperature criteria or test. While a helmet protects your head from impact, we need to ensure that your head is also protected from heat. While internal temperature measurement of firefighting helmets hasn't yet gathered any traction, I suspect it will at a later date.

One user-specific issue that has been brought forward is the size of the hood face opening and how it affects usage in the staged position and as deployed during SCBA use. Development of a test that allows a larger hood-face opening, while maintaining the seal around the SCBA facemask is in the works. This would allow the hood to be worn staged around the larger size neck without the choking feeling that often occurs and also would prevent the hood from creeping down the SCBA mask face shield, which often interferes with the firefighter's field of vision.

Cancer concerns

There is credible scientific evidence that firefighters develop certain cancers in higher percentages than the general public. You can hardly go a day without an email or a line-of-duty death (LODD) notification that involves cancer. With the increasing awareness of cancer, the committee is investigating ways to reduce the firefighter's risk of contamination by the carcinogens produced by fire.

The hood interface between the collar, earflaps and helmet is the only place on the firefighter ensemble that does not have any type of moisture barrier on it. This area also contains the second-most-absorbent area on the body, the area below the angle of the jaw. Does the hood need a moisture barrier? Or does the hood need some type of barrier to prevent permeation of the cancer causing carcinogens produced by the fire? Can we find a product to put on the outside of the hood to prevent pass-through of the particles? The committee formed a task group to investigate the issue, identify problems and formulate potential solutions. Once these three parts of the process are accomplished, the committee can come up with a minimum spec and testing for the product/item.

Evidence of the problem of the hood interface area was noted in "Evaluation of Dermal Exposure to Polycyclic Aromatic Hydrocarbons in Fire Fighters" Report No. 2010-0156-3196 December 2013 by the U.S. Department of Health and Human Services Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). One of their conclusions was that firefighters wearing full ensembles absorb polycyclic aromatic hydrocarbons (PAHs) into their bodies. The report states that PAHs most likely entered the firefighters' bodies through the skin, with the neck being the primary site of exposure and absorption due to the lower level of skin protection afforded by hoods.

The International Association of Fire Fighters (IAFF) LODD statistics show that by the age of 60, twice as many firefighters die from cancer than cardiac arrest. Some of the most common cancers found in firefighters and their respective incidence compared to the general population are:

Testicular cancer	**102%**
Multiple myeloma	**52%**
Non-Hodgkin's lymphoma	**51%**
Skin cancer	**39%**
Brain cancer	**32%**
Prostate cancer	**28%**
Colon cancer	**21%**
Leukemia	**14%**

Dirty gear and burned helmets are not badges of honor anymore! Care, maintenance, contamination, carcinogens and cancer; these are all subjects that, if not already, should be increasingly on every firefighter's radar, from chief to tailboard. At the NFPA 1971 and 1851 committees, along with keeping up with the advances in technology and addressing the concerns of end users, we are trying to address some prevalent aspects of carcinogen contamination and its relationship to the increasing cancer occurrences among firefighters. ■

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