

THERMAL IMAGING CAMERA

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Thermal Imaging Camera use in Size-up for the Oshkosh Fire Department

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and the appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The problem was the Oshkosh Fire Department does not have a comprehensive size-up guideline that includes the use of thermal imaging cameras, thus placing firefighters at possible risk for serious injury or death. The purpose of this research is to identify the issues of utilizing thermal imaging cameras while performing size-up on the fire ground. The descriptive research methodology was utilized to answer four research questions. The questions answered were: (a) What are the national, state, and professional guidelines for utilizing thermal imaging cameras for size-up? (b) What are the technical and professional capabilities of thermal imaging cameras in providing the extent and location of a fire during size-up? (c) What are the thermal imaging camera guidelines used by fire departments in Wisconsin? (d) What are the advantages and disadvantages of using thermal imaging cameras during size-up on the fire ground? The procedures that were used to obtain data were a survey of fire departments in Wisconsin, interviews of fire departments, and an observation of an acquired structure burn. It was found that only ten percent of the fire departments that answered the survey in Wisconsin utilize thermal imaging cameras for size-up on a regular basis. During interviews of fire departments, they reported advantages and positive outcomes to the use of thermal imaging cameras during size-up. The observation of an acquired structure burn found the use of thermal imaging cameras for size-up to be beneficial if a color mode was available. The recommendations were to implement thermal imaging camera usage during size-up and three other operational recommendations were also made. An observation should also be performed on buildings with platform frame and lightweight concrete and steel construction. Future readers should look to fire departments outside of Wisconsin for guidelines on thermal imaging cameras.

Thermal Imaging Camera Use in Size-up

Thermal imaging cameras were introduced into the fire service in the 1980's. One of the first fire departments to utilize thermal imaging cameras was the Fire Department of New York. They had purchased the cameras to be carried on their rescue and haz-mat units. In the 1990's the fire service began to utilize thermal imaging cameras for numerous applications finding down firefighters, searching for missing victims, size-up, fire attack, and overhaul (Anonymous, 2000).

Thermal imaging cameras have also been utilized in a multitude of applications in private industry. Some of the applications that they have been used for are, machine maintenance, loss prevention, occupancy numbers in cars and retail buildings, circuit board maintenance, car maintenance, security, heating, plumbing and electrical systems, and lie detection.

According to Richardson (2001b, ¶8), "thermal imagers have been used to quickly identify hazards, enabling incident commanders to gather information on conditions that were otherwise invisible to the naked eye." The fire ground is a difficult place to operate with rapidly changing fire conditions, unknown building construction, blinding smoke and night-time visibility. Incidents that operate with limited or inaccurate information can cause the loss of life and property (Richardson, 2001b). Utilizing information displayed on the thermal imaging camera about temperature zones within fires, firefighters are able to make informed decisions before entering a structure fire (Careless, 2011).

The National Fire Protection Association statistics show from 1977 to 1995 (as cited in Richardson, 2001c) there were 35 firefighters killed in 16 incidents that had failures in wood-truss construction. Thermal imaging cameras can provide critical information on the structure

components that may prevent accidents from building collapse and other hazards associated with the building (Richardson, 2001c).

The process of size-up is utilized by the fire service to gather and analyze information that will influence the fire officers decision making process (Gustin, 2009). Size-up is utilizing visual clues to evaluate and collect information to formulate decisions. Size-up is a continuous process and an action plan is created from it and can be adjusted as the situation changes. Some factors are time, location, nature of occupancy, life hazard present, exposures, property involved, nature and extent of fire, weather, and resources available (Stowell & Hieber, 2010). There has been information provided in the fire service about utilizing thermal imaging cameras to assist with size-up; however, most of the information provided to the fire service for the use of thermal imaging cameras is for interior fire fighting application.

The problem was the City of Oshkosh Fire Department does not have a comprehensive size-up guideline that includes the use of thermal imaging cameras, thus placing firefighters at possible risk for serious injury or death. The purpose of this research is to identify the issues of utilizing thermal imaging cameras while performing size-up on the fire ground. Descriptive research methodology was selected to guide the following four questions: (a) What are the national, state, and professional guidelines for utilizing thermal imaging cameras for size-up? (b) What are the technical and professional capabilities of thermal imaging cameras in providing the extent and location of a fire during size-up? (c) What are the thermal imaging camera guidelines used by fire departments in Wisconsin? (d) What are the advantages and disadvantages of using thermal imaging cameras during size-up on the fire ground?

Background and Significance

The Oshkosh Fire Department responds to all fire and medical calls in the City of Oshkosh from six stations utilizing four engine companies, two quint companies (combination engine and ladder truck), one rescue company, three ambulances and a command officer. The Oshkosh Fire Department has 104 personnel assigned to the operations division, who are assigned to three shifts with a minimum staffing of 27. In 2010, the Oshkosh Fire Department responded to 7,636 calls for service and 56 of them were structure fires (Oshkosh Fire Department, 2010a).

The National Fire Protection Association (as cited in U.S. Fire Administration, 2010) estimates there were 480,500 structure fires. These fires resulted in 2,695 deaths, 14,740 injuries, and 10,842 million dollars of loss. Residential structure fires accounted for 377,500 of the fires, 2,590 fire deaths, 13,050 injuries, and 7,796 million dollars of loss. Nonresidential structure fires were responsible for 103,500 of the fires, 105 fire deaths, 1,690 injuries, and 3,046 million dollars of loss (U.S. Fire Administration, 2009). The U.S. Fire Administration reported 85 firefighter fatalities in 2010. Performing emergency duties were responsible for 48 percent of the deaths (U.S. Fire Administration, 2010).

According to Bastian (2006b), experienced firefighters know that quality size-up effort at an emergency incident helps ensure that firefighters take quick, efficient steps towards rectifying the emergency. Thermal imagers can be used to collect information early and aggressively, potentially giving officers additional information that improves the odds of a safe and successful resolution. (p. 52)

In the mid 1990's the Oshkosh Fire Department purchased thermal imaging cameras after a local service group had performed multiple fundraisers to raise the money for the purchase.

There would be enough money raised to place a thermal imaging camera in service on all five engine companies. In 1999 the Oshkosh Fire Department re-organized and staffed four engine companies, two quint companies and a rescue company. All engines and quints have thermal imaging cameras as part of their equipment inventory today.

When the author was performing research for the applied research project, “Evaluation of Turnout Gear Maintenance Program for the Oshkosh Fire Department” (Austad, 2008), it was noticed while researching the Fire Fighter Fatality Investigation and Prevention Program from The National Institute for Occupational Health and Safety, that using thermal imaging cameras for size-up was one of the recommendations. This recommendation was observed multiple times in investigation about the fire fighter fatalities that occurred in dwellings. On October 25th, 2008 the author attended a house burn as an instructor for Fox Valley Technical College. The author utilized a thermal imaging camera to determine if the seat of the fire and the extent could be determined for each of the evolutions performed. It was found that it did not provide good information on the seat and extent of the fire. There could have been a few factors affecting the results from this observation, the training of the author in thermal imaging cameras for size-up, the type of building construction, and the model of thermal imaging camera.

The Oshkosh Fire Department does mention the use of thermal imaging cameras in guidelines, but it is only used during investigation of fire alarms (Oshkosh Fire Department, 2010b), and for primary search and investigation for one and two family dwellings (Oshkosh Fire Department, 2008). The Oshkosh Fire Department does not have a guideline specifically on the use of thermal imaging cameras for size-up.

During the course on Executive Leadership (Federal Emergency Management Agency, 2011a) the Vroom-Yetton Decision-Making Model was introduced. Obtaining information of

the location and extent of a fire during size-up is crucial. The Vroom-Yeton Decision –Making Model can be applied to decisions made on the fire ground (Vroom, 1974). In the decision making process there are a series of diagnostic questions that are used.

These questions can assist in determining the most appropriate decision: (a) Is the quality of the decision important? (b) Does the authority figure have sufficient information to make a quality decision? (c) Is acceptance of the decision by subordinates critical to effective implementation? (d) If the authority figure makes the decision alone, is it reasonably certain that it would be accepted by subordinates? (e) Do subordinates share the organizational goals to be attained by solving the problem? (f) Is the decision likely to cause conflict among subordinates? (g) Do subordinates have enough information to make a quality decision? (h) Is the decision well structured and clearly defined?

(Federal Emergency Management Agency, 2011b p. SM 6-9 and 6-10).

The use of thermal imaging cameras during size-up could provide the incident commander on the fire ground crucial information of the structure and assist with tactical decisions. The Vroom-Yeton Decision –Making Model is usually utilized for administrative decisions. The decision making model can be applied to the fire ground in creating the incident action plan. The thermal imaging camera would be a tool that would add to the information needed to be successful with the process of decision making.

This applied research project relates to two of the five United States Fire Administrations goals. The goals are, “improve the fire and emergency services’ capability for response to the recovery from all hazards, and improve the fire and emergency services’ professional status” (United States Fire Administration, 2011). This applied research project will help the Oshkosh Fire Department determine if thermal imaging cameras should be utilized during size-up.

Literature Review

One of the first fire departments to utilize thermal imaging cameras was the Fire Department of New York. They purchased the first cameras in the mid 1980's. In the 1990's, the fire service began to utilize thermal imaging cameras for numerous applications: finding down firefighters, searching for missing victims, size-up, fire attack, track fire growth, egress routes and overhaul (Anonymous, 2000; National Institute of Standards and Technology, 2011). According to Bullard Manufacturing, they have documented 19 firefighters and 5 civilian lives saved by thermal imaging cameras in the past two years (Richardson, 2001a)

In reviewing the National Institute of Safety and Health (1984-2011) Firefighter Fatality Investigation and Prevention Program web page was accessed to review investigative reports of firefighter injury and deaths. This was performed to determine how many structure fires, where fire fighters were injured or killed in dwellings, resulted in thermal imaging cameras being recommended for the department to implement during size-up (National Institute for Occupational Safety and Health, 1984 through 2011).

There are about 7,000 thermal imaging units sold annually throughout the world. In the Asia/Pacific region there are only about 750 cameras available to fire brigades. The more sophisticated markets like Australia, New Zealand, Singapore, Taiwan and Malaysia have accounted for most of the units. The Asia/Pacific region primarily utilizes thermal imaging cameras for interior operations (Moloney, 2005).

Thermal imaging cameras were originally developed for the military during the Korean War. After the war, they began to slowly migrate into industrial applications, but this was not until the 1990's (Barreara, 2006). Honeywell, Hughes Aircraft, and Texas Instruments were some of the first companies to develop the technology utilized in thermal imaging cameras

(Careless, 2011). Some applications that private industry has used them for are lie detection tools in airports (Warmelink, Vrij, Mann, Leal, Forrester, & Fisher, 2011). Loss prevention specialist have used thermal imaging cameras to inspect low-voltage equipment (Anonymous, 2010). They have been utilized as a maintenance tool to pin-point hot spots on production lines to finding leaks in a roof of a factory (Campbell, 2007). They have been utilized to assess energy effectiveness of homes by inspectors to save energy (Sampson, 2006). Retailers have been using thermal imaging cameras to count customers moving in and out of stores (Kroll, 2009). In the United Kingdom, thermal imaging cameras have been used to count the number of passengers in vehicles to help enforce the high occupancy vehicle lanes (Anonymous, 2004). Thermal imaging cameras have also been used as a diagnostic tool in car maintenance, inspection of electronical equipment, design and repair of heating and cooling systems and electrical systems (Anonymous, 2003). It wasn't until EEV and Phillips developed the pyro-electric vidicon tubes that the fire service would begin to see the use of thermal imaging cameras. This would not begin until the 1970's (Careless, 2011).

Industry utilizes thermal imaging cameras for predictive technologies and maintenance. It is utilized to detect overheating mechanical and electrical equipment before it fails. This allows industry to plan for scheduled replacement and avoids costly down time and repairs. Industry also adjusts the noncontact temperature measurement in thermal imaging to reduce the amount of error. This can be done because they are operating in a controlled environment with known surfaces (Bastian, 2003; Katz, 2008).

Thermal imaging cameras are being utilized to scan exteriors of buildings to detect water leaks. They are able to detect water leaks in roofs and find conditions that are favorable to mold (Campbell, 2007). Heating ventilation and air conditioning repair technicians interpret thermal

imaging cameras similar to physicians interpreting x-rays or MRIs. The technician has the knowledge of the heating ventilation and air conditioning systems and they have the experience in what to look for (Dove, 2010).

Certain materials release temperatures at different rates. The term that describes this phenomenon is called emissivity. To be effective in the use of thermal imaging cameras, the user needs to be aware that materials have different emissivity rates. Brick is highly emissive, stainless steel has a low emissivity but is highly reflective and glass is opaque and reflective (Sampson, 2006). Thermal imaging cameras can detect energy through walls and doors. When energy is detected it usually indicates heat on the other side. Thermal imaging cameras also can detect reflected heat off of glass (Jakubowski, 2010).

Thermal imaging cameras function by infrared energy focused onto a focal plane array. The focal plane array is also known as a detector or sensor. The focal plane array is connected to electronics and creates an image which senses energy. Relative differences are calculated and the data is prepared for display. There are three types of technologies that are available to the fire service, barium strontium titanate, vanadium oxide, and amorphous silicon. The vanadium oxide and amorphous silicon utilizes an un-cooled focal plane array sensor. The barium strontium titanate utilizes a small thermoelectric cooler to stabilize the cameras sensor. The barium strontium provides the best imaging quality (Amon, Bryner, Lock, & Hamins, 2008). Vanadium oxide is the newest version available to the fire service and it is small in size and low in cost (Bastian, 2003). The fire service today utilizes vanadium oxide or amorphous silicon sensors. The military has continued the use of the microbolometer technology for their sensors (Careless, 2011). According to Careless (2011), "judging the performance differences between

barium strontium titanate and microbolometer technology is a bit like comparing diesel to gasoline” (p.30).

According to Corbin (2000) infrared light, also known as thermal energy, travels in waves similar to the visible light we use to see; but infrared light is not detectable by our eyes. Thermal energy is also different from the visible light we see with because it is emitted from objects. With visible light, we are able to see things by registering the reflections of a light source bouncing off an object. But infrared light isn't a reflection it comes from with the objects themselves. (p. 64)

The early versions of thermal imaging cameras had a cryogenically cooled detector. The cameras were large, heavy and not portable. The cost was over \$50,000, used batteries at a rapid rate, and had high maintenance costs. The microbolometer or vanadium oxide does not have to be cryogenically cooled and is available at a lower cost (Lancaster, 2005). Most of the detectors utilized for the fire service are un-cooled (Amon, Bryner, Lock, & Hamins, 2008).

According to Amon, Bryner, Lock, & Hamins (2008), thermal imaging cameras need to have performance metrics and test methods for the fire service to provide “images to have sufficient contrast, temperature range, spatial resolution, and thermal sensitivity” (p.76). Thermal imaging cameras must be strong enough to withstand high temperatures, adverse weather conditions, and changes in humidity. The camera must also produce an image that can be beneficial for the operator (Amon, Bryner, Lock, & Hamins, 2008).

The National Fire Protection Association recently released the Standard on Thermal Imagers for the Fire Service, NFPA 1801. This standard was released in 2010, and was designed to provide uniform guidelines for companies to manufacture thermal imaging cameras with consistency in the fire service. The standard does not have any direction on the use of the device

for the fire service (National Fire Protection Association, 2010). The Wisconsin's Administrative Code from the Department of Commerce Chapter Comm 30 is the administrative rule that governs municipal fire departments in Wisconsin. Subchapter VII is on vehicles and equipment does not have any mention of thermal imaging cameras for required equipment or its use (Wisconsin's Administrative Code, 2011).

Bastian (2006a) identifies a list of guidelines for using thermal imaging cameras: (a) It should be used to compare areas of the building with each other noting where heat has accumulated. (b) Take a comparison to have an understanding what is being displayed on the camera. (c) A thorough understanding of building materials is needed to determine how they affect the transfer of heat. (d) Understand how high heat producing sources like the sun and boiler rooms can affect the signature on the camera. (e) Verify where the suspected heat source may be with the use of inspection holes. (f) Do not utilize thermal imaging cameras as the only technique to determine if a heat signature is a hidden fire. The Brookfield Fire Department (2011), Eau Claire Fire Department (2009), Fond du Lac Fire Department (2009), La Crosse Fire Department (2008) and the Oak Creek Fire Department (2005) were contacted and provided guidelines on using thermal imaging cameras. The data collected from the guidelines provided was described in the results section.

A thermal imaging company has documented in two years time that their thermal imaging camera was used by 25 firefighters to evaluate the building structure as it was failing. The use of the thermal imaging camera allowed firefighters to escape the structures before injury occurred (Richardson, 2001c). The proper use of thermal imaging cameras can create success stories on the fire ground. The thermal imaging camera identifies where a hidden fire has

warmed the surface in comparison to the other areas and they cannot see through building materials (Bastian, 2006a).

The first arriving company officer/incident commander should assess the incident by taking a tour of the site if at all possible. The absence of witnesses or outside visible indicators like smoke and/or fire would indicate a walk around of the site before the committing of any resources (Stowell, 2007). Practicing good size-up procedures on fire scenes can assist the company officer and/or the incident commander in starting their operation. Adding a thermal imaging camera to the operation of size-up can help the company officer and/or the incident commander determine how aggressively to deploy resources. The thermal imaging camera can also assist with the success of the termination of the incident while maintaining firefighter safety (Bastian, 2005).

To have success with thermal imaging cameras, the camera needs to come off the fire apparatus. Bastian (2004) recommends that fire departments following four steps. The first step is fire departments should have guidelines on the operation of the unit including on what incidents and who should be using it. The second step is the camera should be located in an area of the apparatus where it can be easily accessible. The third step is training should be performed with the camera. During training evolutions the camera should be carried while performing fire ground activities to acclimate the user on how to handle the camera. The fourth step is to standardize how the fire fighter carries the camera. Training evolutions can be developed in non-fire situations to recognize different construction features. These evolutions should include looking at the building to see if portions are hotter than others during different seasons. Determine if rain has any impact on what you see. Also look at structures to see if the type of

construction can be identified by the heat escaping, are studs visible or is the masonry wall hiding them or is the buildings mass affecting the heat signature.

According to Cline (2003), thermal imaging cameras can be utilized for exterior and interior size-up. Thermal imaging cameras can be helpful in locating the seat of the fire. They also can show fire behavior, and location of the seat of the fire when heavy smoke conditions exist. Interior size-up is performed by viewing with a six sided technique. The six sides would be floor, floor to ceiling, and four sides.

Size-up identifies and evaluates conditions on the fire ground and it begins with dispatch and continues for the duration of the emergency scene (Woodworth, 1997). Thermal imaging cameras can assist in size-up and provide information before even entering the building. Items that can be viewed from the outside include the seat of the fire, observing changing fire conditions, building construction features and conditions that could affect structural integrity (Harvey, 2010). For thermal imaging cameras to be utilized as an asset during size-up the camera needs to arrive early. Thermal imaging cameras should be located on front line fire apparatus. They should be used during non-fire size-up to provide practice in the use of the camera. The camera should also be located in an area readily available, preferably by a firefighter position to assure easy access when arriving on scene (Bastian, 2006b).

Commercial fires present dangerous situations to firefighters because the buildings are large, fire load is substantial and the building construction hinders responders. It is often forgotten that thermal imaging cameras can provide information to fire personnel before sending firefighters inside of a building. Building construction is the biggest factor affecting the quality of information that is received because of the amount of heat that is retained by the building (Bastian, 2007).

Firefighters encounter many obstacles on the fire ground that makes their job difficult. Some of these obstacles are rapidly changing conditions, unknown building construction components, blinding smoke, and poor night time visibility. Some hazards are invisible to the naked eye and initial information gathered on the scene quickly and accurately can assist in having good outcomes on the fire ground. Most of these obstacles can be addressed with the use of the thermal imaging cameras. The incident commander would be able to collect the information and be able to make informed decisions on resources needed and where they need to be deployed (Richardson, 2001b).

Thermal imaging cameras are becoming the “7th sense” (Tippett, 2009, p. 58) used for firefighting. First arriving companies should utilize thermal imaging cameras when performing size-up. This will get a baseline of temperatures from the building. With heavy smoke conditions, there is a fuel rich environment that coupled with the right amount of oxygen, a flashover condition can occur faster than a fire fighter can recognize. Several line of duty deaths and numerous injuries occur each year from rapid fire development (Tippett, 2009). Even before firefighters enter the structure, the incident commander is able to assess and find the seat of the fire, observe fire progress and spread, identify critical building construction features, and monitor threats to structure integrity from the outside (Richardson, 2001c).

Two of the most significant size-up applications at structure fires are locating the seat of the fire or hidden heat and identifying critical structural components. Different seasons of the year have affect on how thermal imaging cameras identify heat signatures. The sun also has an effect on the cameras operations. Practice with thermal imaging cameras should occur in non-fire situations in all seasons to see the affects of heat transfer inside of the structure in non-fire situations. It also prepares the operator on comparing the temperature differences within a

structure (Bastian, 2005). In light construction buildings of a type V structure, the thermal imaging camera can give clues on the location of the fire (Richardson, 2001c). Thermal imaging cameras identify the location of the most dangerous parts of fire. This assists firefighters in determining a safe approach into the structure. Thermal imaging cameras also assess floors and ceilings to determine if they have become weakened from the fire (Corbin, 2000).

The incident commander determines the extent and location of the fire, but should also determine and identify the type of building construction. The naked eye or preplans may identify critical building components like roof type, but in most cases this may not be available. The thermal imaging camera may be able to identify if the building has a façade surrounding the roof or bow string trusses that are hidden by a flat roof. When these critical components have been identified, the progress of the fire should be monitored to assure their integrity (Richardson, 2001c).

Locating the seat of the fire can be accomplished with a thermal imaging camera in lightweight construction, but in buildings of heavier construction it may be difficult to determine the seat of the fire. In heavy construction buildings, try to look at the area where insulation may be thinner, this is usually around doors, windows and roof assemblies. A thermal imaging camera can also be utilized to identify heat buildup under the roof structure (Harvey, 2010). The thermal imaging camera can be utilized by the incident commander to look at the thermal load and the potential of risk to adjoining structures. The camera can also assist with locating flaming brands within the plume of smoke (Anonymous, 1998).

Thermal imaging cameras can assist in the location of fires in knee walls. During the exterior size-up with the camera, heat signatures should be identified. A fire in a knee wall

would be indicated by heat being uniform from the eave to the peak of the roof. If the fire was not in the knee wall, the peak would be significantly hotter than the eaves (Hart, 2008).

Commercial structures today are being mostly built as a type III construction. This type of construction is made up of lightweight concrete walls, usually concrete block or a lightweight masonry wall system. The roof system is usually a flat roof created with metal web trusses with decking on top including insulation. This lightweight construction allows heat to escape quicker than compared to heavier construction allowing the thermal imager to pick up the heat signatures better (Bastian, 2007).

In commercial buildings made of concrete and steel, when the seat of the fire is found, extension can be determined easily. In wood frame structures this may not be so easy because of void spaces. A thermal imaging camera may be able to find the seat of the fire and predict the path of the fire spread (Richardson, 2001c).

Thermal imaging cameras may not provide good information on buildings made of masonry construction. In wood frame structures, because of the density and mass of the materials used, thermal imaging cameras are beneficial in locating and determining the extent of the fire (Woodworth, 1997).

With homes and businesses trying to strive to become more energy efficient, this has made thermal imaging cameras more inefficient. “Insulation in the walls, floors and ceilings, low-E window glass, radiant floor heating, skylights and other steps taken to limit the transfer of heat into or out of a structure has all had an impact on thermal imaging operations” (Harvey, 2009). Thermal imaging cameras can only pick up heat that has transferred to the surface of the material. Thermal imagers cannot see through solid objects. The shades displayed or being viewed are relative to the each other for the amount of heat being emitted (Bullard Thermal

Imager, 2001). As building construction gets lighter, firefighters will have less time to work inside of the structures. The lightweight construction does provide an advantage as it will emit heat at a faster rate to the outside of the structure and thermal imaging cameras will be able to identify what is occurring inside (Bastian, 2007).

Thermal imaging cameras are not able to see through glass. The shinier the surface the less effective the camera is (Corbin, 2000). Thermal imaging cameras cannot detect heat through windows, but it can detect temperature changes in glass. Low-E glass is designed to limit emissivity of heat, which makes detecting heat through a Low-E glass window difficult during size-up. Thermal imaging cameras rely on building materials that have high emissivity values to allow them to pick up the high heat signatures during a fire (Harvey, 2009).

Insulation has a value assigned to it called an R-value. The higher the R-value insulation has, the better the insulation qualities. “Each behaves differently when evaluated by a thermal imager. If you have become used to using your thermal imager for building size-up, then you know how valuable it can be in revealing areas of natural heat accumulation such as walls, windows and roofs; however, the better insulated a home, the more difficult it is to notice such heat signatures” (Harvey, 2009).

”Skylights are becoming more popular since they are a source of natural light and reduce the dependency of the structure on electricity for interior lighting. These skylights are typically difficult to assess with a thermal imager because they are often reflective on the outside of the glass as well as the interior of the shaft” (Harvey, 2009).

Some problems with thermal imagers are the interpretation. The operator needs to know and understand what they are looking at. The operator needs to become proficient with the device and avoid becoming over confident. The lack of visibility has kept individuals somewhat

safe in the past when we would be on our hands and knees. The thermal imaging camera has given eye sight back but, the firefighter still needs to be cognizant of their surroundings to identify hazards (Eisner, 2000). Thermal imaging cameras cannot see through walls, but it can see what the heat level is in the other room. These limitations can be worked through with proper training on the cameras (Corbin, 2000).

In summary, private industry has been utilizing thermal imaging cameras for a multitude of applications, lie detection, inspection of low voltage equipment, to identify hot spots on production lines, leaks in roofs, energy effectiveness, counting customers for retailers, tracking the number of passengers in cars in high occupancy lanes, and car maintenance. The National Fire Protection Association did create NFPA 1801 in 2010 for thermal imaging cameras, but the standard was primarily for the regulation of manufacturing.

The operator of a thermal imaging camera needs to be competent in the operation of camera to have it be beneficial on the fire ground for size-up. With energy efficiency being an expectation of society, this makes it more difficult for the thermal imaging camera to detect heat on buildings. The high insulation value in walls and windows reduce the speed in which heat is emitted from a building.

Several line of duty deaths and numerous injuries occur each year from rapid fire development (Tippett, 2009). There have been numerous success stories about the use of thermal imaging cameras in size-up. A thermal imaging camera can be utilized to identify the seat of the fire, location and extent of the fire, building construction, and critical building components. The thermal imaging camera may be able to identify if the building has a façade surrounding the roof or bow string trusses that are hidden by a flat roof.

Procedures

To assure that triangulation of data was accomplished and to gain the most accurate information, a survey, interviews, and an observation of an acquired structure burn were the procedures utilized in the study. A survey was created (Appendix A) to be distributed throughout Wisconsin. Questions on the survey were created to determine if the department has a thermal imaging camera, how long have they had one, what and how many fire apparatus carry one, does the department utilize the camera for size-up, and if they utilize it for size-up do they have a guideline for it.

The survey was distributed throughout Wisconsin utilizing the State of Wisconsin Fire Chiefs Association list serve. According to A. Bronson (personal communication, May 17, 2011) (Appendix G) the State of Wisconsin has 857 fire department and 499 of them are members of the State of Wisconsin Fire Chiefs Association. The State of Wisconsin Fire Chiefs association was the best avenue for contacting as many fire departments in the State of Wisconsin as possible. An email was received from P. Silva Jr., (personal communication, September 19, 2011) (Appendix F) Education Director – Fire Service Education and Training for the Wisconsin Technical College System, he stated that 857 fire departments in the State of Wisconsin was correct, and there is not a breakdown between career versus volunteer. He also states there is no list serve with email addresses for all departments in the State of Wisconsin. Many fire departments in Wisconsin do not have full time personnel or clerical staff, so contact may need to be done directly through the fire chief's personal phone. The survey was distributed by the State of Wisconsin Fire Chief's list serve on May 28, 2011. From the initial survey, 90 replies were received. The survey was distributed by the State of Wisconsin Fire Chief's list serve a second time on June 2, 2011 and had thirty one replies. From the survey being

distributed two times there were 121 replies total. This equated to 24.2 percent of the fire departments responding with an overall response of 14 percent of all fire departments in the State of Wisconsin (Appendix B).

The fire departments that responded to the survey and answered yes to utilizing a thermal imaging camera for size-up, and had a guideline for its use during size-up, were contacted for an interview. Interviews were selected to assure information was captured that could not be obtained from a survey. An email was sent to each of the members that responded answering they utilize thermal imaging cameras for size-up and have a guideline on August 20, 2011. From the email distributed, seven out of the thirteen responded. Contact was made with the seven fire departments that responded to the email by phone and an interview was completed. The six that did not respond by email had a second email sent to them. None of the six that had a second email sent to them responded so a follow-up phone call was provided. From the follow-up phone call, five of the six were able to be contacted and an interview was performed by phone. Interview questions (Appendix C) were as follows: do they train on the use of thermal imaging camera for size-up, how they perform the training, have they had any good and bad outcomes utilizing thermal imaging cameras during size-up, and are there any advantages or disadvantages noticed with utilizing a thermal imaging camera during size-up. A total of twelve people were interviewed utilizing the interview questions in Appendix C.

A phone interview was conducted with S. Beer (personal communication, September 1, 2011) (Appendix D) Assistant Chief for Fond du Lac Fire Department. A phone interview was conducted with C. Meyers (personal communication, September 1, 2011) (Appendix D) Fire Chief for Brookfield Fire Department. A phone interview was conducted with E. Kassing (personal communication, September 2, 2011) (Appendix D) Fire Chief for Eau Claire Fire

Department. A phone interview was conducted with W. Thomas (personal communication, September 2, 2011) (Appendix D) Deputy Chief for La Crosse Fire Department. A phone interview was conducted with T. Rosandich (personal communication, September 2, 2011) (Appendix D) Assistant Chief for Oak Creek Fire Department. A phone interview was conducted with J. Resac (personal communication, September 2, 2011) (Appendix D) Fire Chief for Rice Lake Fire Department. A phone interview was conducted with A. Felde (personal communication, September 2, 2011) (Appendix D) Fire Chief for Vernon Fire Department. A phone interview was conducted with D. Kerkman (personal communication, September 2, 2011) (Appendix D) Fire Chief for Wisconsin Rapids Fire Department. A phone interview was conducted with C. Olson (personal communication, September 7, 2011) (Appendix D) Fire Chief for Campbellsport Fire Department. A phone interview was conducted with D. Zeiler (personal communication, September 8, 2011) (Appendix D) Fire Chief for Grantsburg Fire Department. A phone interview was conducted with A. Wegner (personal communication, September 14, 2011) (Appendix D) Deputy Chief for Mukwonago Fire Department. A phone interview was conducted with D. Brahm (personal communication, September 15, 2011) (Appendix D) Fire Chief for Lisbon Fire Department.

An observation of an acquired structure burn for Fox Valley Technical College was performed on June 4, 2011. There were three thermal imaging cameras that were used, Scott®, MSA, and Dräger. Training was provided by the representatives from the companies to the author in the use of the cameras. Literature was also obtained from all three cameras and reviewed by the author. Three fire instructors were selected to operate the thermal imaging cameras during the burn. All three personnel were trained on the use of the camera by the author

and reviewed the literature provided by the representatives prior to the structure burn (Appendix H).

The description of the structure was a one and a half story wood frame. The structure was a balloon frame type construction. The observation was performed for four fires, three on the second floor and one on the first floor. An observation was only performed for three burn evolutions on the second floor because of the residual heat signature that occurred after the third fire. Because the burn evolutions were performed back to back on the second floor, the structure did not have time to cool which presented with residual heat built up in the structure on the second floor after the third observation. The fourth fire evolution that was observed was on the first floor, this was the sixth burn evolution sequence overall. At this time in the burn evolution, there was no heat signatures noticed on the first floor. The room on the first floor was selected because it was an interior room with no walls or windows to the outside of the structure. After this evolution was completed, the whole first floor had heat signatures that the thermal imaging cameras identified before the next burn evolution was started. At this time the observation ended.

For each evolution of the burn, all three thermal imaging cameras were utilized to determine location and extent of the fire. For each fire, the instructors did not know where the location of the fire would be. After the fire was started and communicated through command, 360 degree size-up was performed on each fire by all three instructors. The author observed and documented the findings from the instructors and the cameras (Appendix H).

There were four limitations that were encountered with this applied research project. The first limitation was only three different types of thermal imaging cameras could be represented at the acquired structure burn. The second limitation that was encountered was the structure was

balloon frame construction. Fire fighters respond to multiple types of structures, a platform frame construction and/or a lightweight concrete and steel building would have been great addition to the research to perform an observation on. The third limitation was due to limited federal and state guidelines on the use of thermal imaging cameras. The fourth limitation was the limited response to the email survey. All departments that responded to the survey answered yes to having a thermal imaging camera. It could be said departments that do not have a thermal imaging camera may not have answered the survey. Only 13 departments in the State of Wisconsin had a guideline for the use of a thermal imaging camera during size-up.

Results

This section will answer the four research questions used to guide this research project. The research questions used were: (a) What are the national, state, and professional guidelines for utilizing thermal imaging cameras for size-up? (b) What are the technical and professional capabilities of thermal imaging cameras in providing the extent and location of a fire during size-up? (c) What are the thermal imaging camera guidelines used by fire departments in Wisconsin? (d) What are the advantages and disadvantages of using thermal imaging cameras during size-up on the fire ground?

The first research question was: (a) What are the national, state, and professional guidelines for utilizing thermal imaging cameras for size-up. In reviewing National Fire Protection Association and Administrative rules for Wisconsin, there were no standards found on the use during fire operations of a thermal imaging camera during size-up.

Fire fighter fatality reports where a firefighter was injured or killed in a dwelling were queried from 1984 through 2011. The reports were accessed to identify if a recommendation was made to the fire department for the use of a thermal imaging cameras for size-up. There

were 71 reports that were reviewed and 35 incidents had no mention of thermal imaging cameras, 23 had size-up as a recommendation and 13 had size-up with the use of thermal imaging camera mentioned. The recommendation of thermal imaging camera use during size-up did not appear until after the year 2002. There were only 36 reports from 2002 to present that were reviewed (National Institute for Occupational Safety and Health, 1984 through 2011). The National Institute for Occupational Safety and Health has made the recommendation for the use of thermal imaging cameras since 2000. With this recommendation, the use of thermal imaging cameras during size-up has become a best practice in the fire service.

The second research question was: (b) What are the technical and professional capabilities of thermal imaging cameras in providing the extent and location of a fire during size-up. An observation of an acquired structure burn with Fox Valley Technical College was performed on June 4, 2011. There were four fires that were observed with thermal imaging cameras to assist in answering question number two (Appendix H).

The intent of the observation was to utilize the thermal imaging camera to obtain information of a structure during a fire evolution to determine the location and origin of the fire, fire extension, and to determine critical building components. The first three fires were located on the second floor, and all rooms of origin had an exterior window to the room. The fourth fire was located on the first floor. This room of origin was chosen because it was the only room of origin that was located in an interior room without windows or outside walls (Appendix E).

There were three thermal imaging cameras utilized for the observation. Each camera had different modes that were utilized to determine which setting worked the best. Camera one was a Dräger UCF 3200 and it had six different modes. Camera two was a MSA Evolution® 5800 and it had five modes that were utilized. The modes were white hot imagery, black hot imagery,

fire and ice imagery, fusion imagery, and rainbow imagery. Camera three was a Scott® Eagle Imager 320 and it had three modes, temperature awareness colorization, overhaul mode, and black and white. The operators of the thermal imaging cameras did not know the location of any of the fire evolutions in the structure. This was accomplished to assure they did not have prior information of the seat of the fire to allow the best results to be found from the thermal imaging camera. A 360 walk around of the structure began when command gave the direction to light the fire. The walk around continued until command gave the direction to begin fire attack and continued through the extinguishment phase. This was performed to capture multiple stages of fire growth to assess the cameras abilities to identify fire progression and extension. The cameras were evaluated for how well they worked on finding the seat and location of the fire along with fire extension. The ease of operation of the thermal imaging cameras was not evaluated.

The first fire was located on the second floor and identified as burn evolution number one on the acquired structure burn diagram (Appendix E). The room of origin had one window into the room. With camera one, full color pallet was found to be superior over standard gray scale and reverse gray scale. Heat signatures were noticed by the window in the room turning yellow. Windows in adjacent rooms were black until heat transfer occurred. When the heat transfer occurred, there was still a significant difference noticed between the room of origin and adjacent rooms. The temperature noted on the camera was 300 degrees (Appendix H).

With camera two, the black hot imagery setting identified the best heat signature on the structure. In the black hot imagery, after 280 degree color starts to come into the view. Convected heat was noticed collecting at the eaves above the window leading to the room of origin. The window to the room of origin was located on a gable end of the structure. Fire and

ice imagery was the next best setting. Fusion and rainbow imagery modes were found to be too colorful to determine differences of heat within the structure to locate the seat of the fire. The temperature that was noted on the structure was 300 degrees (Appendix H).

With camera three, the temperature awareness colorization mode identified the best heat signature on the structure. The black and white mode was very difficult and found to need a lot of interpretation on heat differentials. The temperature that was noted was 580 degrees (Appendix H).

The second fire was located on the second floor and identified as burn evolution number two on the acquired structure burn diagram (Appendix E). The room of origin had one window into the room. With camera one, the full color pallet presented the best information. It was easy to notice the room of origin by the yellow color of the windows. The windows in adjacent rooms only had a portion of the window that was yellow (Appendix H).

With camera two, the black hot imagery provided the best information on the location of the seat of the fire. Fire and ice, when used looking at the building straight on, provided the best information; but when the camera looked at the building at an angle a glare was received from the radiant heat. White hot imager, fusion imagery and rainbow imagery, when utilized, were very hard to determine the room of origin (Appendix H).

Camera three had the same findings as the first fire with the temperature awareness colorization mode identifying the seat and location of the fire the best. The black and white mode again proved to be difficult to determine the heat differences that would provide good information to seat and location of the fire. To receive the most accurate temperature reading on camera three, the structure needed to be looked at straight on, not at a glance (Appendix H).

The third fire was located on the second floor and identified as burn evolution number three on the acquired structure burn diagram (Appendix E). The room of origin had one window into the room. Camera one noticed some residual heat from the previous fire, but it was still noticeable what room the seat of the fire was in. As in fire one and two, full color proved to be the best option and gave the best information on seat and location of the fire (Appendix H).

With camera two, fire and ice imagery provided the best information. The black hot imagery was able to pick up the convected heat venting from adjacent windows. Fusion imagery on this fire did prove to be beneficial if looking at the structure straight on. Using camera three, the temperature awareness colorization mode provided the best information even with the residual heat from the previous two fires. The black and white mode did not provide any information, all windows presented bright white (Appendix H).

The fourth fire was located on the first floor and identified as burn evolution six on the on the acquired structure burn diagram (Appendix E). With camera one, the full color pallet provided the best information. The fire needed to progress to a certain stage before a change in temperature was noted within the structural components. The room of origin did not have a window; however, flames were seen in the window to the room adjacent before a heat signature was noted on the camera (Appendix H).

With camera two, the black hot imagery provided the best information and could see the heat building up around the door that leads to the room of origin. It was also noted the door was hollow core by the heat signatures present. Fire and ice imagery was the second best; the white hot, fusion and rainbow imagery did not provide good information on the location and seat of the fire. Using camera three, the temperature awareness colorization mode identified heat in the

window well after visible fire could be seen. The black and white mode was difficult to notice any heat signatures (Appendix H).

In summary of the observation, for camera one, full color produced the best information. Camera two found black hot imagery produced the best information. Black hot imagery starts as a black and white screen but when temperatures reach 280 degrees color is added to the screen. The temperature awareness colorization in camera three provided the best results. The day the observation was performed, it was clear skies and sunny, this presented some difficulty at times seeing the color variations. The structure that was used was a wood frame construction, but because of its age, would not be considered lightweight construction.

The third research question was: (c) What are the thermal imaging camera guidelines used by fire departments in Wisconsin. From the survey (Appendix A), thirteen out of the 121 fire departments that responded to the survey identified they had a guideline that utilized thermal imaging cameras during size-up. Access to the survey participants was obtained through the good offices of A. Bronson (personal communication, May 17, 2011) (Appendix G) and P. Silva, Jr. (personal communication, September 19, 2011) (Appendix F).

An attempt was made to interview a representative from each department and to obtain a copy of the document. Interviews were performed with representatives of twelve fire departments that had mentioned they have a guideline on the use of thermal imaging cameras in size-up. The Campbellsport Fire Department (C. Olson personal communication, September 7, 2011) (Appendix D) and Wisconsin Rapids Fire Department (D. Kerkman personal communication, September 2, 2011) had a guideline on the use of thermal imaging cameras, but they did not specifically mention the use during size-up. Guidelines from the Fond du Lac Fire Department, (2009), Brookfield Fire Department (2011), Eau Claire Fire Department (2009), La

Crosse Fire Department (2008) and Oak Creek Fire Department (2005) were reviewed and the use of thermal imaging cameras for size-up was not mentioned specifically. All five guidelines provided direction on uses and limitations of the thermal imaging cameras. The author was unable to obtain the guidelines from the remaining fire departments for review.

Municipal fire departments in the State of Wisconsin are governed by Wisconsin's Administrative Code (Wisconsin's Administrative Code, 2011) from the Department of Commerce Chapter Comm 30. Wisconsin is not considered an Occupational Health and Safety Administration State; the Department of Commerce is the organization that regulates municipalities. Subchapter VII is on vehicles and equipment does not have any mention of thermal imaging cameras for required equipment or its use (Wisconsin's Administrative Code, 2011).

The National Fire Protection Association standard NFPA 1801 2010 on thermal imaging cameras does not have any direction on the use of the device in the fire service. The standard was designed to provide uniform guidelines for companies to manufacture thermal imaging cameras with consistency in the fire service (National Fire Protection Association 1801, 2010).

The fourth research question was: (d) What are the advantages and disadvantages of using thermal imaging cameras during size-up on the fire ground. A phone interview was conducted with S. Beer (personal communication, September 1, 2011) (Appendix D) Assistant Chief for Fond du Lac Fire Department. An advantage is it takes the guessing game away from locating the seat of the fire. The Fond du Lac Fire Department has had some success stories with fires in attics and basements. A phone interview was conducted with C. Meyers (personal communication, September 1, 2011) (Appendix D) Fire Chief of Brookfield Fire Department. An advantage with thermal imaging cameras is you are able to see things normally not seen with

the naked eye. You are able to see other hazards during the 360 degree walk around that otherwise go unnoticed because of darkness or smoke conditions.

A phone interview was conducted with E. Kassing (personal communication, September 2, 2011) (Appendix D) Fire Chief for Eau Claire Fire Department. An advantage noticed by their department is you are able to peer through the smoke and identify the seat of the fire. A phone interview was conducted with W. Thomas (personal communication, September 2, 2011) (Appendix D) Deputy Chief for LaCrosse Fire Department. The thermal imaging camera assists in getting a good head start on the size-up of the incident and assists in finding the seat of the fire. It also helps in the selection of the entrance to a structure to assure it is made on the unburned side.

A phone interview was conducted with J. Resac (personal communication, September 2, 2011) (Appendix D) Fire Chief for Rice Lake Fire Department. The camera assists in giving an idea on where the seat of the fire is. It also reaffirms your gut feeling on the location of the fire while performing your 360 degree walk around. His department had a good success story with fire in a balloon frame construction building where the fire traveled from the basement to the attic. They were able to see the fire extension and pinpoint the access point they needed.

A phone interview was conducted with A. Felde (personal communication, September 2, 2011) (Appendix D) Fire Chief for Vernon Fire Department. The thermal imaging camera almost slows people down while doing their size-up to assure they are getting all the information they need. A phone interview was conducted with D. Kerkman (personal communication, September 2, 2011) (Appendix D) Fire Chief for Wisconsin Rapids Fire Department. The thermal imaging camera assists in the scenario of the structure and identifies where the seat of the fire is located.

A phone interview was conducted with A. Wegner (personal communication, September 14, 2011) (Appendix D) Deputy Chief for Mukwonago Fire Department. The thermal imaging camera assists with determining if there really is something or not during the size-up. A phone interview was conducted with D. Brahm (personal communication, September 15, 2011) (Appendix D) Fire Chief for Lisbon Fire Department. The camera helps with the decision process whether to go with an interior or exterior offensive attack. This eliminates the danger by determining if the fire should be accessed from the inside or the outside by cutting into the structure.

A phone interview was conducted with S. Beer (personal communication, September 1, 2011) (Appendix D) Assistant Chief for Fond du Lac Fire Department. One of the disadvantages found with thermal imaging cameras is mirrored rooms or reflections cause double image. Thermal imaging cameras cannot see through glass and the shinier the surface the less effective the camera is (Corbin, 2000). According to A. Felde (personal communication, September 2, 2011) (Appendix D) Fire Chief for Vernon Fire Department, limitations are needed to be understood, like trying to see through glass or shiny object.

A phone interview was conducted with D. Kerkman (personal communication, September 2, 2011) (Appendix D) Fire Chief for Wisconsin Rapids Fire Department. He indicated thermal imaging cameras are difficult to use in direct sunlight. A phone interview was conducted with C. Olson (personal communication, September 7, 2011) (Appendix D) Fire Chief for Campbellsport Fire Department. The biggest disadvantage is assuring training is performed so the operator understands what they are looking at. A phone interview was conducted with D. Zeiler (personal communication, September 8, 2011) (Appendix D) Fire Chief for Grantsburg

Fire Department. A disadvantage can come from relying to heavy of the technology of the thermal imaging camera; it is another tool that cannot be solely relied upon.

A phone interview was conducted with E. Kassing (personal communication, September 2, 2011) (Appendix D) Fire Chief for Eau Claire Fire Department. Older models of thermal imaging cameras are more difficult to use and provide limited information compared to new units. They need to be used and if they are not convenient to use, they will not be used consistently. A phone interview was conducted with T. Rosandich (personal communication, September 1, 2011) (Appendix D) they were able to use the thermal imaging camera with a block of resin to determine its core temperature, and they were able to handle it appropriately by the camera giving them reliable information about the temperature of the product. The older cameras were bulkier and difficult to use.

Discussion

The National Fire Protection Association in 2010 created NFPA 1801, a standard for thermal imaging cameras. This standard did not have any operational or fire ground recommendations for use of thermal imaging cameras. This standard was created as a guideline for manufacturers of the production of the camera (National Fire Protection Association 1801, 2010). The State of Wisconsin has an administrative code that governs operations and required equipment for fire departments in the State of Wisconsin. Department of Commerce Chapter Comm 30 does not have any mention of the use or requirement of thermal imaging cameras (Wisconsin's Administrative Code, 2011). Only ten percent of the fire departments that answered the survey utilize a thermal imaging camera during size-up. The guidelines on thermal imaging cameras were reviewed from five fire departments, and the use of thermal imaging cameras

were not specifically mentioned. Guidelines could not be obtained from the other departments that mentioned they had one in the survey.

Thermal imaging cameras are becoming the “7th sense” (Tippett, 2009, p. 58) used for firefighting (Tippett, 2009). First arriving companies should utilize thermal imaging cameras when performing their 360 degree size-up. Several line of duty deaths and numerous injuries occur each year from rapid fire development (Tippett, 2009). Two of the most significant size-up applications at structure fires are locating the seat of the fire or hidden heat and identifying critical structural components. The thermal imaging camera can assist with gaining information for both of the significant applications of size-up (Bastian, 2005).

Utilizing thermal imaging cameras during the size-up process has become a best practice in the fire service. A size-up should be completed on all structure fires and started by performing a 360 walk around of the structure. Adding a thermal imaging camera to the operation of size-up can help the company officer and/or the incident commander determine how aggressively to deploy resources (Bastian, 2005). The National Institute for Occupational Safety and Health has made the recommendation for the use of thermal imaging cameras since 2000. With this recommendation, the use of thermal imaging cameras during size-up has become a best practice in the fire service.

The structure utilized for the observation was a one and a half story wood frame. The wood frame construction was a balloon frame type. With this older type of construction of the structure utilized during the acquired structure burn, it would be expected to see heat transfer to the outside occurring much quicker than a newer home. With homes trying to become more energy efficient, this has made thermal imaging cameras more inefficient. “Insulation in the walls, floors and ceilings, low-E window glass, radiant floor heating, skylights and other steps

taken to limit the transfer of heat into or out of a structure has all had an impact on thermal imaging operations (Harvey, 2009).” The lightweight construction does provide an advantage as it will emit heat at a faster rate to the outside of the structure and thermal imaging cameras will be able to identify what is occurring inside (Bastian, 2007).

Thermal imaging cameras can assist in size-up and provide information before even entering the building. Items that can be viewed from the outside include the seat of the fire, observing changing fire conditions, building construction features and conditions that could affect structural integrity (Harvey, 2010).

There are three types of technologies utilized in the thermal imaging cameras that are available to the fire service, barium strontium titanate, vanadium oxide, and amorphous silicon. The vanadium oxide and amorphous silicon utilizes an un-cooled focal plane array sensor. The barium strontium titanate utilizes a small thermoelectric cooler to stabilize the cameras sensor. The barium strontium provides the best imaging quality (Amon, Bryner, Lock, & Hamins, 2008). Vanadium oxide technology is the newest version available to the fire service and it is small in size and low in cost (Bastian, 2003).

According to Corbin (2000) infrared light, also known as thermal energy, travels in waves similar to the visible light we use to see; but infrared light is not detectable by our eyes. Thermal energy is also different from the visible light we see with because it is emitted from objects. With visible light, we are able to see things by registering the reflections of a light source bouncing off an object. But infrared light isn't reflection, it comes from within the objects themselves. (p. 64)

There are six items that need to be understood to properly use a thermal imaging camera during size-up. It should be used to compare areas of the building with each other noting where

heat has accumulated. Taking a comparison to have an understanding what is being displayed on the camera. A thorough understanding of building materials is needed to determine how they affect the transfer of heat. Understand how high heat producing sources like the sun can affect the signature on the camera. Verify where the suspected heat source may be with the use of inspection holes. Do not utilize thermal imaging cameras as the only technique to determine if a heat signature is a hidden fire (Bastian, 2006a).

The sun has an effect on the cameras operations. Practice with thermal imaging cameras should occur in non-fire situations in all seasons to prepare the operator on comparing the temperature differences within a structure (Bastian, 2005). This was identified during the observation performed at the acquired structure burn.

The proper use of thermal imaging cameras can create success stories on the fire ground, however, they cannot see through building materials. The thermal imaging camera identifies where a hidden fire has warmed the surface in comparison to the other areas (Bastian, 2006a). Interviews performed on the twelve fire departments found they all had success stories in utilizing thermal imaging cameras during size-up. Only two departments reported bad outcomes during the use of cameras during size-up. The Wisconsin Rapids Department (D. Kerman personal communication, September 2, 2011) stated they had a bad outcome but there were other factors involved with balloon frame and a positive pressure fan. The bad outcome could not have been directly linked to the thermal imaging camera. The Grantsburg Fire Department (D. Zeiler personal communication, September 8, 2011) stated they had a bad outcome when they first started utilizing a thermal imaging camera for size-up. He stated it was unfamiliarity with the camera and didn't know what they were looking at. Training was utilized to correct the issue.

Thermal imaging cameras identify the location of the most dangerous parts of fire. This assists firefighters in determining the safest entry into the structure. They also assess critical structural components like floors and ceilings to determine if they have become weakened from the fire (Corbin, 2000). Thermal imaging cameras can assist in the location of the seat and location of the fire in lightweight construction, but in buildings of heavier construction it may be difficult to determine the seat of the fire (Harvey, 2010).

Thermal imaging cameras can assist in the location of fires in knee walls. During the exterior size-up, a fire in a knee wall would be indicated by heat being uniform from the eave to the peak of the roof. If the fire was not located in the knee wall, the peak would be significantly hotter than the eaves (Hart, 2008). To have success with thermal imaging cameras, the unit needs to come off the fire apparatus. The camera should be located in an area of the apparatus where it can be easily accessed (Bastian, 2004).

The guidelines reviewed from the fire departments in Wisconsin on the use of thermal imaging cameras found no specific information on the use of the camera during size-up. The guidelines addressed operation and maintenance of the camera. However, the literature and the success of the observation does indicate the thermal imaging camera to be a best practice for the Oshkosh Fire Department to utilize during size-up to identify the seat of the fire, recognize fire growth and extension, and evaluate critical building construction components.

The implication of this study for the Oshkosh Fire Department was significant. From the observation performed at the acquired structure burn, the color option on thermal imaging cameras provided the best information. The black and white mode of operation provided little or no benefit. The Oshkosh Fire Department does have thermal imaging cameras on all front line fire companies. The cameras are a 1990's model that only has black and white mode and are

inadequate for size-up. The City of Oshkosh, because of reduction of shared revenues from the State of Wisconsin, will have a budget deficit of one million dollars. This will affect the Oshkosh Fire Department's 12 million dollar budget by the need to cut approximately 300,000 dollars from the budget. Because of the budget crisis being experienced in the City of Oshkosh, the only possibility for replacement is to write a grant to replace the thermal imaging cameras.

Recommendations

The recommendations from this applied research project were submitted to Tim Franz, Fire Chief of the Oshkosh Fire Department in a formal letter (Appendix I). The recommendations from the results were: (a) implement thermal imaging camera usage during size-up, (b) perform training on acquired structure burns and structure of different building construction, (c) retrofit apparatus to have thermal imaging cameras readily available, (d) purchase new thermal imaging cameras that have color capability. An observation should be performed on buildings with platform frame and lightweight concrete and steel construction to determine if the results would be consistent to the original observation on the balloon frame construction building. Because Wisconsin fire departments had limited guidelines available on the use of thermal imaging cameras for size-up, future readers should look to fire departments outside of Wisconsin for guidelines.

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Appendix A

Thermal Imaging Camera Survey

- 1) Department name: _____
- 2) Person completing survey: _____
- 3) Does your department have a thermal imaging camera?
yes/no
- 4) If your department has a thermal imaging camera, how long have you had one?
1-5 years 6-10 years 11-15 years
- 5) Does every first in fire truck have one (engine, ladder, rescue, or command vehicle)?
N/A
Engine(s) yes/no
Ladder(s) yes/no
Rescue(s) yes/no
Command vehicle yes/no
- 6) Does your department utilize thermal imaging cameras for size-up?
Yes/no N/A
- 7) If thermal imaging cameras are used for size-up, do you have a policy or guideline that provides direction for their use?
Yes/no N/A
- 8) If your department utilizes thermal imaging cameras for size-up, could I contact you for more information?

Contact information

Name:

Phone number:

Email address:

Appendix B

Thermal Imaging Camera Survey Findings

- 121 Departments answered the survey
- How many departments answering the survey have thermal imaging cameras

121 Yes

- How long have department answering the survey had thermal imaging cameras

1-5 years	4 Departments
6-10 years	57 Departments
11-15 years	50 Departments
15 years +	9 Departments
Varies	1 Department

- Which vehicles carry a thermal imaging camera

116 Engine
41 Ladder
36 Rescue
11 Command vehicle
1 Tender

- How many departments answering the survey utilize thermal imaging cameras for size-up

53 Yes
68 No

- How many departments answering the survey have a policy outlining the use of thermal imaging cameras for size-up.

13 Answered yes

Appendix C

Interview

Name and title of Person being interviewed:

Name of Fire Department:

Date and Time of Interview:

Type of Interview:

- 1) Does your department train on the use of thermal imaging camera for size-up?
- 2) How do you perform the training (i.e. live house burns, burn building or scenarios)?
- 3) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?
- 4) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?
- 5) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?
- 6) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Appendix D

Name and title of Person being interviewed: Steve Beer, Assistant Chief

Name of Fire Department: Fond du Lac

Date and Time of Interview: September 1, 2011 15 minutes

Type of Interview: Phone

7) Does your department train on the use of thermal imaging camera for size-up?

Yes

8) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Training is performed in burn buildings and on structures without fire.

9) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

Located fire in an attic and was able to place a vent hole in a safe area. Found the location of a fire in the basement and was able to find extension.

10) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

No

11) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

It takes the guessing game away from locating the seat of the fire and extension.

12) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Only disadvantage is mirrored rooms or reflection causing double image.

Appendix D

Name and title of Person being interviewed: Charlie Myers, Fire Chief

Name of Fire Department: Brookfield

Date and Time of Interview: September 1, 2011 15 minutes

Type of Interview: Phone

13) Does your department train on the use of thermal imaging camera for size-up?

Yes

14) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Training is performed in the classroom only with scenarios.

15) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

The camera is used on every fire to locate the room and location.

16) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

No

17) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

The advantages are seeing things that you don't with the naked eye, like heat signatures on a roof. You can see other hazards in the yard that you would not normally notice during the 360 degree walk around because of darkness and/or smoke conditions.

18) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Only disadvantage is not enough cameras.

Appendix D

Name and title of Person being interviewed: Ed Kassing, Fire Chief

Name of Fire Department: Eau Claire

Date and Time of Interview: September 2, 2011 15 minutes

Type of Interview: Phone

19) Does your department train on the use of thermal imaging camera for size-up?

Yes

20) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Training is performed at training facility along with simulation on fires. Any time doing active training they use them also.

21) Has your department had any good outcomes utilizing thermal imaging cameras

during size-up?

Yes

22) Has your department had any bad outcomes utilizing thermal imaging cameras

during size-up?

No

23) Are there any advantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

Advantages are being able to see the seat of the fire and peer through the smoke.

24) Are there any disadvantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

The camera needs to be thought of as another tool. The older models are more difficult to use and it is difficult to get all members to use. If the cameras are not convenient to use, there won't be the buy in to use them.

Appendix D

Name and title of Person being interviewed: Warren Thomas, Deputy Chief

Name of Fire Department: La Crosse

Date and Time of Interview: September 2, 2011 15 minutes

Type of Interview: Phone

25) Does your department train on the use of thermal imaging camera for size-up?

Yes

26) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Training is performed in burn building with live fire training.

27) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

Last large fire the shift commander found the seat of the fire.

28) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

No

29) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

It gives you a good head start on size-up, and helps find the seat of the fire. It helps in choosing which entrance to use to come in from the unburned side.

30) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

No

Appendix D

Name and title of Person being interviewed: Tim Rosandich, Assistant Chief

Name of Fire Department: Oak Creek

Date and Time of Interview: September 1, 2011 15 minutes

Type of Interview: Phone

31) Does your department train on the use of thermal imaging camera for size-up?

Just performs the basic training on them.

32) How do you perform the training (i.e. live house burns, burn building or scenarios)?

They have used them on live burns, and use at every fire.

33) Has your department had any good outcomes utilizing thermal imaging cameras

during size-up?

Had a 250-300 lbs block of resin that was on fire and they placed it into a tank of water and were able to watch it cool with the thermal imaging camera.

34) Has your department had any bad outcomes utilizing thermal imaging cameras during

size-up?

No

35) Are there any advantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

Necessary tool for locating the fire above heads and seeing the temperature changes inside a structure.

36) Are there any disadvantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

Older cameras were large and bulky and the black and white was difficult to see variations in heat.

Appendix D

Name and title of Person being interviewed: James Resac, Fire Chief

Name of Fire Department: Rice Lake

Date and Time of Interview: September 2, 2011 15 minutes

Type of Interview: Phone

37) Does your department train on the use of thermal imaging camera for size-up?

No

38) How do you perform the training (i.e. live house burns, burn building or scenarios)?

A project is in the works for the technical college to provide training in 2012.

39) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

Had a fire that whet from the basement to the attic in a balloon frame structure and was able to find the fire from the outside to pin point the location.

40) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

No

41) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

You get an idea were the location of the fire is. The camera also reaffirms your gut feeling on the location of the fire during the 360 degree walk around.

42) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Older units the batteries have short operating time of 30 to 35 minutes. The black and white picture is difficult to determine heat levels.

Appendix D

Name and title of Person being interviewed: Alex Felde, Fire Chief

Name of Fire Department: Vernon

Date and Time of Interview: September 2, 2011 15 minutes

Type of Interview: Phone

43) Does your department train on the use of thermal imaging camera for size-up?

Yes

44) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Training is performed at acquired structures and in burn building at the local technical college.

45) Has your department had any good outcomes utilizing thermal imaging cameras

during size-up?

Found the fire in the attic from below. Found fire in the attic from the outside by locating the seat of the fire by seeing the white spot on the roof.

46) Has your department had any bad outcomes utilizing thermal imaging cameras

during size-up?

No

47) Are there any advantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

Almost slows people down to take the time to look at things closely.

48) Are there any disadvantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

The camera has limitations and you need to know and understand them. An example is trying to look through a window or reflective object.

Appendix D

Name and title of Person being interviewed: Dave Kerkman, Fire Chief

Name of Fire Department: Wisconsin Rapids

Date and Time of Interview: September 2, 2011 15 minutes

Type of Interview: Phone

49) Does your department train on the use of thermal imaging camera for size-up?

Yes

50) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Have an old house for training, and used the TIC for size-up. Performed training in an old nursing home that was masonry construction for size-up.

51) Has your department had any good outcomes utilizing thermal imaging cameras

during size-up?

Had a fire in a bar with apartments above with heavy smoke showing upon arrival and the IC was able to find the seat of the fire during size-up with the camera.

52) Has your department had any bad outcomes utilizing thermal imaging cameras during

size-up?

Had a few but there were other factors involved, one being a balloon frame structure and the use of a positive pressure fan.

53) Are there any advantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

Helps with the scenario on the structure and tells you where the seat of the fire is along with the extent.

54) Are there any disadvantages that your department has noticed with utilizing a thermal

imaging camera during size-up?

They are difficult to use in direct sunlight.

Appendix D

Name and title of Person being interviewed: Craig Olson, Fire Chief

Name of Fire Department: Campbellsport

Date and Time of Interview: September 7th, 2011 15 Minutes

Type of Interview: Phone

55) Does your department train on the use of thermal imaging camera for size-up?

Initial training was performed when the units were purchased. Continuous training is provided.

56) How do you perform the training (i.e. live house burns, burn building or scenarios)?

The Bullard unit came with a video, and there is a computer program that goes along with it. A test was also provided. Training is also implemented into monthly training with scenarios.

57) Has your department had any good outcomes utilizing thermal imaging cameras

during size-up?

Yes, it helps in pinpointing the fire location. Works well on the fire where you show up and only smoke is showing but no fire.

58) Has your department had any bad outcomes utilizing thermal imaging cameras

during size-up?

No

59) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Helps out with the size-up of the situation and where the location of the fire is.

60) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Biggest disadvantage is the training on the unit to know what they are suppose to be looking at.

Appendix D

Name and title of Person being interviewed: Derek Zeiler, Fire Chief

Name of Fire Department: Grantsburg

Date and Time of Interview: September 8th, 2011 20 minutes

Type of Interview: Phone

61) Does your department train on the use of thermal imaging camera for size-up?

No training specific on size-up, just general thermal imaging camera classes.

62) How do you perform the training (i.e. live house burns, burn building or scenarios)?

The training provided was on live burns in acquired structures, burn buildings and scenarios.

63) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

The thermal imaging camera is very helpful on basement fires. Usually use one camera in the basement and the other on the first floor. Had a fire in the basement and it started in the utility room and burned through the floor joist, and the camera was able to pick this up.

64) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

First couple times using the camera personnel didn't realize what they were looking at. It took some time and experience to use them.

65) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Assistant chiefs have utilized them for the walk around of the structure and have helped find the fire. The camera gives a quick scan of the area.

66) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Glass or reflective materials cause problems on the view. Some people rely on technology too much. Does not show heat on the ceiling when the fire is in the attic involving the insulation, but you can see the heat in the attic.

Appendix D

Name and title of Person being interviewed: Andy Wegner, Deputy Chief

Name of Fire Department: Mukwonago

Date and Time of Interview: September 14, 2011 10 minutes

Type of Interview: Phone

67) Does your department train on the use of thermal imaging camera for size-up?

Yes

68) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Hands on training in practice burns with acquired structures.

69) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

Yes, fire in the downtown district, side by side buildings. Smoke investigation utilizing the thermal imaging camera on the interior wall found the fire.

70) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

No

71) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Knowing if you really have something or not in the initial size-up. Helping determine best entry point into the structure, by fire locations noticed by camera.

72) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Problems are not remembering taking it with them for size-up and the bulkiness of the unit and how to carry it.

Appendix D

Name and title of Person being interviewed: Doug Brahm, Fire Chief

Name of Fire Department: Lisbon

Date and Time of Interview: September 15, 2011 15 minutes

Type of Interview: Phone

73) Does your department train on the use of thermal imaging camera for size-up?

Yes, every officer uses the camera as part of the combat tactics.

74) How do you perform the training (i.e. live house burns, burn building or scenarios)?

Very fortunate had a lot of acquired structures in the past years to assist with training.

75) Has your department had any good outcomes utilizing thermal imaging cameras during size-up?

Yes

76) Has your department had any bad outcomes utilizing thermal imaging cameras during size-up?

No

77) Are there any advantages that your department has noticed with utilizing a thermal imaging camera during size-up?

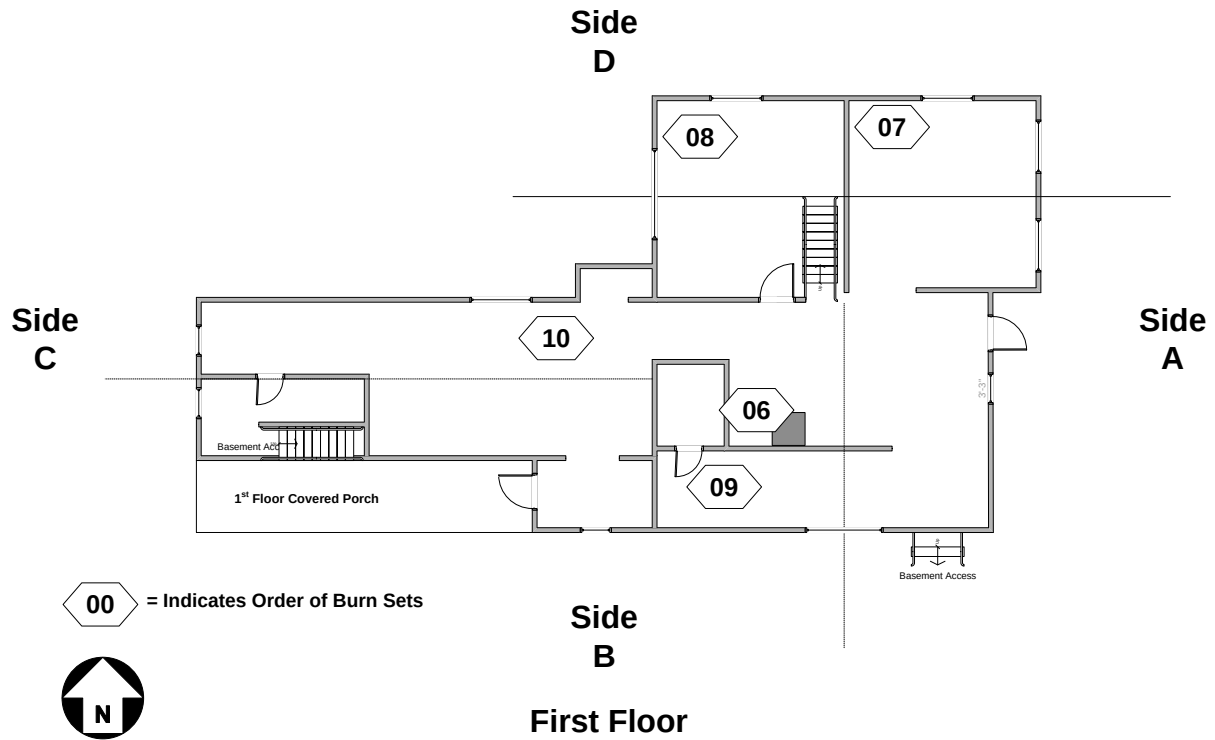
It is an integral part of the size-up to determine tactics to be deployed. The camera helps with the decision making process whether to go with interior or exterior offensive mode. It eliminates the danger by determining the safest entry into the building to select an area that is not affected.

78) Are there any disadvantages that your department has noticed with utilizing a thermal imaging camera during size-up?

Only disadvantage is it is another piece of equipment that needs to be checked, maintained, and managed.

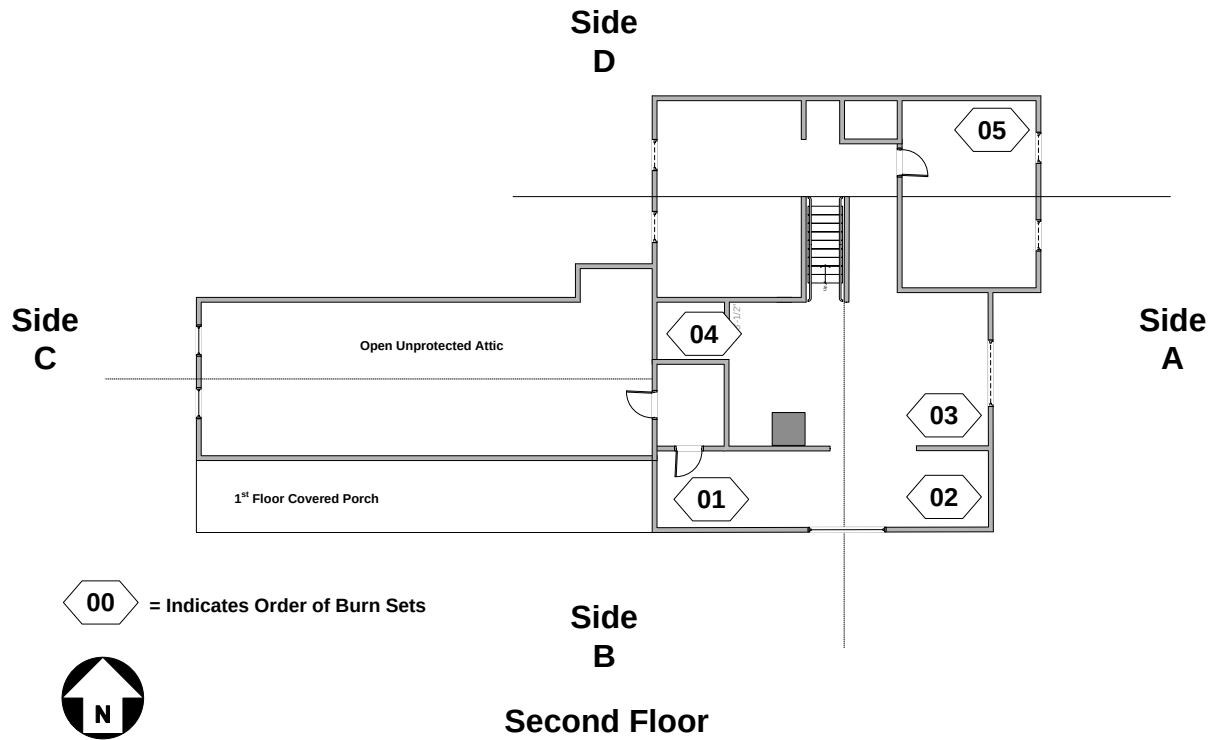
Appendix E

Acquired Structure Burn June 4, 2011 N4231 Cty Road C, Freedom, WI



Appendix E

Acquired Structure Burn June 4, 2011 N4231 Cty Road C, Freedom, WI



Appendix F

From: Silva, Peter [mailto:peter.silva@wtcsystem.edu]
Sent: Monday, September 19, 2011 7:58 AM
To: Austad, James D.
Subject: RE: Wisconsin Fire Department Information

Good morning Chief,

As for total amounts, the 857 figure is correct but I don't have a breakdown of volunteer vs. career, etc. The only all-inclusive list of contact information I know of you can find at <http://dsps.wi.gov/sb/sb-fireprevention-firedepartments.html>. There currently is no list serve with email addresses for all departments as far as I know, I wish there was. As for contacting fire departments, of course there are many departments that have no full time staff or secretaries, so reaching some chiefs entails calling their personal phone numbers.

If you are working on something that could remedy this, i.e. gathering emails, creating a list serve, that would be fantastic. I'm currently trying to figure out an easy way to supply every chief with current information and the Chiefs and Instructors organizations only have so much.

Let me know if you need any other information, hope to chat more with you in the future.

Pete

Peter Silva, Jr.
Education Director- Fire Service Education & Training
Wisconsin Technical College System
4622 University Ave
Madison, WI 53705

Appendix G

From: Andrew Bronson [mailto:info@wsfca.com]
Sent: Tuesday, May 17, 2011 10:45 AM
To: Austad, James D.
Subject: Re: Survey

Jim,

Sorry for the delay. There are currently 499 (out of 857) departments represented that have members in WSFCA.

Thanks,

Andrew

Appendix H House Burn Data

Instructors: Jake Meyers, Eric LaFave, and Lee Kasten

0830: Briefing and familiarization provided to instructors on the use and operation of thermal imaging cameras.

0900: Overall briefing provided by command with all personnel operating at the acquired structure burn.

Purpose: Utilize thermal imaging camera to identify where the origin and seat of the fire is along with fire extension and progress from the outside of the structure. An attempt should be made to identify building construction components.

Procedure: When command has signaled the fire has been started to start a 360 degree walk around utilizing the thermal imaging camera. Another 360 degree walk around will be performed when command signals the fire attack to began. Command should be notified if out of the ordinary observations are made that could affect the safety of crews operating inside the structure.

Building Type: Wood frame, balloon type construction, 1 ½ stories tall with double hung windows without storm windows.

0933: Start of the 1st burn.

Fire #1 on “B” side of the structure, second floor, evaluators did not know the location of the fire and a 360 degree walk around was performed.

Drager (Lee)

- Full color pallet three was the best
- Heat signature on the window turned bright yellow
- Adjacent windows were black until the transfer of heat occurred, but still a significant difference between the room of origin and adjacent rooms.
- 300 degrees

MSA (Eric)

- BH was the best, however, the temperature needs to be over 280 before the color comes out in the black and white mode. Could also see the heat collecting at the eaves above the window in the room of origin. The window was in a gable end of the building.
- C-1 next best
- C-2 and C-3 were too colorful and it was difficult to determine differences
- 300 degrees

Scott (Jake)

- Tac Mode was the best

- Black and white very difficult, a lot of interpretation needs to be done.
- 580 degrees.

Fire #2 on “B” side of the structure, second floor, evaluators did not know the location of the fire and a 360 degree walk around performed.

Drager (Lee)

- Windows were yellow, but only a portion of the window in the adjacent room indicated the room of origin.

MSA (Eric)

- WH Black and white hard to determine room of origin
- C-2 straight on was the best, if at an angle got a glare from the radiant heat.
- BH had the best picture with the color showing through

Scott (Jake)

- Temperature reading was different when looking straight on verses at a glance.

Fire #3 on “A” side of the structure, second floor, evaluators did not know the location of the fire and a 360 degree walk around performed.

Drager (Lee)

- Had some residual heat from previous fires, but was still able to tell the difference to determine room of origin by the brightness of the yellow.

MSA (Eric)

- C-1 was the easiest to read, C-2 worked well if looking straight on. BH could see convected heat coming from an adjacent window.

Scott (Jake)

- Tac mode best color variation and could see the room of origin, even with the pre-existing heat signature.
- Black and white did not work, all the windows were white.

Fire #4 on “A” side of the structure, first floor interior room, evaluators did not know the location of the fire and a 360 degree walk around performed.

Drager (Lee)

- Full color pallet was the best option, but needed the fire to be burning to get the window hot enough to indicate heat on the outside.

MSA (Eric)

- BH could see the heat building up at the window when it got hot enough. It was also noted the heat on the doorway adjacent to the window that lead to the room of origin. The heat signature also recognized the door was a hollow core, because the honey combing of the door could be seen with the heat signature.

Scott (Jake)

- Tac mode was the best, but could see the fire in the window, but it was a while before the glass indicated the heat through the camera.

Notes: The sun the day of the burn made it difficult at times to see the differences in color to determine heat signatures.

Appendix I

City of Oshkosh Fire Department
101 Court St.
Oshkosh, WI 54901
(920) 236-5247

James Austad
Battalion Chief of EMS



Tim Franz, Fire Chief
Oshkosh Fire Department
101 Court Street
Oshkosh WI, 54901

September 18, 2011

Dear Chief Franz,

As you know my applied research project for the executive fire officer program was Thermal Imaging Camera use in Size-up for the Oshkosh Fire Department. The recommendations from the results of the applied research project would be: implement thermal imaging camera usage during size-up, perform training on acquired structure burns and structure of different building construction, retrofit apparatus to have thermal imaging cameras readily available, and purchase new thermal imaging cameras that have color capability for each front line apparatus to include the command car.

I would recommend the change of adding the use of the thermal imaging camera to our size-up procedure early in 2012. The replacement of the thermal imaging cameras would need to be purchased on either capital improvement expenditure or grant if we would be successful.

I will forward a copy of applied research project for your review. If you have any further questions, please feel free to contact me.

Sincerely,

James Austad

Author Note

I would like to recognize the help that Lee Kasten, Eric LaFave and Jake Myers provided in evaluating the thermal imaging cameras during the acquired structure burn. I would also like to recognize Oshkosh Fire and Police Equipment, Bendlin Fire Equipment, and Paul Conway Shields for the use of the thermal imaging cameras.