STANDARD OPERATING GUIDELINE FOR THERMAL IMAGING CAMERAS

EXECUTIVE LEADERSHIP

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ABSTRACT

This research project identified information that would be beneficial in the development of a standard operating guideline for the use of thermal imaging cameras.

The problem was that the Spokane Valley Fire Department did not have a standard operating guideline for the use of three cameras that it had on order.

The purpose of this applied research project was to develop a standard operating guideline that would provide for the safe use of thermal imaging cameras on the incident scene.

The research employed was both descriptive and action to discover (a) what limitations are being identified regarding thermal imaging cameras, (b) what training should be required prior to utilizing a thermal imaging camera on an incident, and (c) under what conditions are other fire service organizations allowing the use of thermal imaging cameras?

The principle procedures used were a review of current literature and a questionnaire sent to eighty-one fire service organizations from around the nation. This questionnaire was used to further define thermal imaging issues within the fire service.

The findings of the research project were that there are both significant benefits associated with thermal imaging technology as well as limitations. With proper training and control most of these limitations can be mitigated safely.

The recommendations resulting from this research project included the following:

1. All personnel, prior to the use of a thermal imaging camera, should complete and demonstrate competency in the use of their thermal imaging camera.

2. Personnel may only use the make and model of cameras that they have been trained to use.
3. The priority of thermal imaging camera use on an incident shall be, (a) the first camera on scene is available for any use, (b) the second camera shall be assigned to RIT, (c) the third or any additional cameras on scene are available for any use.

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INTRODUCTION

The Spokane Valley Fire Department (SVFD) is a progressive organization that has historically utilized new technologically, both in advanced tools and practices, as soon as it was financially or operationally capable. Within that tradition the Department has studied the different types and advantages of thermal imaging cameras (TIC) and selected the most appropriate units for purchase. The Department currently has three units on order.

The problem for the Department was that it had no standard operating guideline for the use of thermal imaging cameras on the fireground or elsewhere. Thermal imaging cameras have tremendous potential to assist firefighters in providing safer and more efficient services to our community. The cameras also have the potential, if used in ways that are uncontrolled or untrained, to provide opportunities for firefighters to get into situations that may be more hazardous than if they had not had this new technology available.

The purpose of this research project was to develop a standard operating guideline for the authorized utilization of thermal imaging cameras on incidents that would provide for safe use of this new technology on the fireground and other incidents.

Descriptive and action research methods were utilized to answer the following questions:

1. What limitations are being identified regarding thermal imaging cameras?
2. What training should be required prior to utilizing a thermal imaging camera on an incident?
3. Under what conditions are other fire service organizations allowing the use of

thermal imaging cameras?

BACKGROUND AND SIGNIFICANCE

The SVFD is a fire protection district that provides services to an area of over 74 square miles, with a population of approximately 115,000 citizens. The Department's assessed evaluation is over 4.9 billion comprised of single and multiple housing units as well as over four thousand business occupancies. The businesses include manufacturing, light and heavy industry, agriculture, transportation, and many others. The 2001 budget is over 14.7 million. It is a department that has one hundred and thirty five paid professional firefighters, seven stations, ten staffed responding apparatus and responded to over 7,500 calls in 2000.

The Department defines its purpose within the community with its mission statement, " The Spokane Valley Fire Department is an all-risk emergency agency, protecting its citizen's lives, property, and the environment through a cost effective and responsive people oriented service" (Spokane Valley Fire Department, 1994). Because the Department defines its mission as all risk, it provides services including basic life support, advanced life support, fire suppression, inspection, arson investigation, technical rescue services and many others.

The SVFD is a progressive and up to date department. As an example of its commitment to stay current, the oldest front line pumper is a 1992 model. As new technology is developed it looks for ways to integrate that technology into the Department's operations.

Thermal imaging cameras are one of the current new technologies that are affecting the fire service's operations around the country. Crickenberger and Sojka (2000) report that there were an estimated 7,500 thermal imaging cameras in use by the

fire service in 1999, and it is projected that there will be 100,000 in use within the next several years. This huge increase is possible considering reports like that from Roundtable Opinions From Around The Country (2000) stating New Jersey is planning to provide all of the state's fire departments with one thermal imaging camera at a reported cost of some $7.5 million.

The use of this type of technology is not new. Some of the earliest thermal imaging detectors were used in the 1960's during the Vietnam War to see through darkness and smoke (Corbin, 2000). One of the first fire departments to use this technology was the New York Fire Department. They provided a camera for their hazardous materials company #1 in late 1986 (Gallager, 1991).

The benefits to the fire service, as more cameras come into use, are the varied ways in which they will assist in fulfilling their missions and services. Some of the current areas that TIC's are being utilized are in size-up, fire attack, search and rescue, finding fire extension, command, hazardous materials, water rescue, rapid intervention teams, wildland fires and overhaul to name a few (Image Is Everything, 1998).

The increased effectiveness of search and rescue efforts with cameras can be amazing. In 60 structure fire drills firefighters trying to locate victims without TIC's were only 40% successful. Firefighters with a TIC found the victim 99% of the time and in 25% less time (Stevens, 1999). Many instances are being reported on how TIC's are assisting in accomplishing the missions or assisting in firefighter safety.

In Grandbury, Texas, the Fire Department credited a TIC for allowing the identification of several ceiling joists that had burned through. The occupancy was an auto body shop, and an officer scanned the interior to find the safety hazard. The

interior crews were withdrawn, and the ceiling collapsed moments later. Four lives may have been saved (Imager Saves Firefighters, 1999). A TIC was credited for saving the life of a person missing in a two-story structure fire in Charlottesville, Virginia. The search crew found the person in about five minutes in what they believed would have been a fifteen-minute search without the camera (Richardson & Scholer, 1999). During a flood in North Carolina a TIC was used to search for victims on approximately a half-mile of wooded shoreline in about ten minutes (Pease, 1999). A TIC was also used to locate twenty-one people trapped in the rubble after the Oklahoma City bombing (Kienlen, 1999).

As helpful as this technology is, the Department needs to remember that the National Fire Protection Association (NFPA), National Institute of Safety and Health (NIOSH), and the Occupational Safety and Health Administration are not yet involved; there are no standards currently established (Eisner, 2000). Fire departments must remember that a TIC is just a tool to enhance previously trained practices and procedures. If the TIC fails we need to fall back on our standard techniques and practices (Cook, 2000).

With standard operating procedures for their use, a TIC will make a difference in a department's operations (Roundtable Opinions, 2000). The SVFD is pursuing this new technology and all that it has the potential to offer because it wants to provide the safety and abilities that a TIC could provide. An effective standard operating guideline (SOG) for its use and training programs for our personnel will help assure that the Department is prepared for this new step forward with safety as the ultimate goal.

The vision to pursue the future and its technological opportunities, the leadership and SOG's needed to direct where it will take our department were topics of discussion in my Executive Leadership class at the National Fire Academy in March of 2001.

LITERATURE REVIEW

A review of the current literature was performed for this applied research project to identify information on how thermal imaging cameras are being utilized in the fire service, what training is being suggested and or required, what features on cameras are available and being discussed, and if there is any reporting of possible issues of concern.

In the early 70's and 80's, the new technology in disentanglement tools swept through the fire service. The technology of today is thermal imaging cameras. The fire service needs to decide whether thermal imaging cameras are an essential tool or a convenience (Image Is Everything, 1998).

Historically, infrared technology was developed to meet the military's needs in the 1960's during the Vietnam War. These systems were large and complex and operated at extremely low temperatures. They had to be cryogenically cooled before they became sensitive enough to discern low levels of infrared energy (Corbin, 2000). In the 1970's, Texas Instruments developed thermal technology for the U.S. Air Force who used it in aircraft to identify enemy targets (Spivak, 1999). The first systems not requiring super-cooling were called pyroelectric vidicom (PEV) and used sensors similar to a camera tube. The tubes contained materials that registered minute temperature variations. PEV's were problematic in that they were unable to produce an image as high in picture quality as the cryogenically cooled systems and were difficult to use in

applications involving fire (Corbin, 2000). The U.S. Navy, who had thousands of them, utilized the first widely used thermal imager. The Navy recommended these imagers not be pointed at a heat source for more than a few seconds or it would damage the vidicom tube (Can you see Through Smoke, 1998). The thermal imaging systems that are used today, as identified by both Corbin (2000) and Spivak (1999), utilize solid-state technology that was introduced in the 1980's, which provides high-quality images and can detect very small changes in heat. These cameras are smaller, easier to use, uncooled, and significantly less expensive.

The development of this technology has allowed it to expand into the fire service market. Currently, there are numerous manufacturers providing cameras, including Bullard, ISI, MSA, Texas Instruments, Safety Scan, Fire Research, and Cairns. These cameras can range in cost from $17,000.00 to $26,000.00, depending on selected options (Can you see Through Smoke, 1998; Image Is Everything, 1998). Estimates indicate that about 10 percent of fire departments nationwide have thermal imaging units, and the percentage is increasing every day (Corbin, 2000). In the United Kingdom the percentage of fire departments that have cameras increases to between 70 and 80 percent (Lyons, 1998).

The various manufacturers offer a wide variety of options, based on the available technology and design, to the fire service. Some of the alternatives identified by Colley (1999) are hand held units, helmet mounted, vehicle mounted, sleep mode, heads up display, weight options, automatic brightness control, full color survey mode, monochrome picture, remote transmitter, 6 volt or 10 volt NiCad batteries, nickel hydride batteries, automatic iris, swivel eyepieces and numerous others. One manufacturer

developed an integral pyrometer, which when incorporated into the thermal imager, enables the user to identify and read off temperatures up to 500 degrees centigrade (Humpoletz & Leckie, 1998). The design of thermal imaging devices should be driven by the fire service, and it should push for manufacturers to integrate its needs into future designs (Roundtable Opinions, 2000).

The uses of thermal imaging technology and cameras are many and very diverse. Love (1999) discussed how industrial firefighters use cameras to identify temperature differences that are unavailable to the naked eye, using the heat to their advantage. Woodworth (1995) identified some of the more traditional uses as size-up, wildland fires, smell of smoke determination, hazardous material spills, water rescues, command, fire floor location, amount of structural involvement, and overhaul. In Image Is Everything (1998) they listed more areas including command in the sky, search and rescue, and use with rapid intervention teams. In Thermal Imaging Cameras (2000) they spoke about the advantages of TIC's in assuring firefighter accountability on incident scenes and along this line of use is also the camera's ability to assist in monitoring students during training exercises to provide for their safety (Siuru, 1996). Another good use of the camera's ability to identify heat signatures is in identifying defects in electrical wiring and identifying hot spots in switching gear.

There are many examples where the use of cameras are having a beneficial effect on the fire service's ability to provide safer working conditions for the firefighters and better service to their citizens. Lyons and Parmenter (1995) describe a situation where during a structure fire in a motor vehicle repair shop, two cylinders were found in the early stages of the fire. The cylinders were in the main part of the fire, and it is

believed that without the camera finding them and allowing them to be cooled, they would have exploded causing serious consequences to the firefighters. Another example of their ability to assist is described by Roundtable Opinions (2000) where a crew with no visibility in a hallway used the camera to see which room was involved. They could see heat at the door, and it saved them a great deal of time not having to check each door one at a time. Colley (1999) gives an example where the camera can be used outside of structures. There was a diesel tanker on fire in the middle of a busy highway, and the department had a very limited water supply. They used the camera to identify and cool the hot spots on the tanker, and in that way, maintained the integrity of the tanker as much as possible.

Hartin (1997) reports that the use of thermal imagers will greatly reduce the time it takes to find the source of fires and its extension. Firefighters that are using TIC's are indicating a belief that their use has the potential to reduce death and property damage by as much as fifty percent (Kosiarski, 1993). When you look at all of the potential uses of TIC's, Cogan (1992, p.38) probably stated it the best by saying, " The uses of thermal imaging cameras are only limited by the imagination of the user".

Thermal imaging cameras offer so many advantages, but with the wide variety of options and manufacturers, they also present a number of limitations to the user. A great deal of consideration should be given to familiarizing the user with those limitations in order to allow safe use of the camera. Spivak (1999), who describes a camera feature called reverse imaging, illustrates one example of this. This feature allows heat-producing objects to appear dark, rather than white. It does not enhance the image, but it does make it appear more realistic. Eisner (2000) also sees the image

as a potential concern. He describes departments utilizing one type of camera, becoming familiar with its image, and subsequently encountering another type of camera that presents the image in a different way. This situation could be very dangerous for the user.

Another concern is the effect of water. Cogan (1992) illustrates how a thermal imaging camera may not present an accurate image in areas where sprinkler systems are discharging because of the shielding effect of the water. A firefighter following an attack line may be presented with an unclear image because the imager is again, trying to see through a water stream (Lyons, 1998).

Thermal imagers are incapable of seeing through glass. The more shiny the surface, the less effective the camera will be at sensing the heat of that surface. A pane of glass will act like a mirror in the camera's display. What the camera is reading is the reflected heat signature from another location. Dark colors and duller surfaces have a higher 'emissivity' rating and radiate infrared energy more readily, while lighter colors and shiner surfaces radiate less effectively (Corbin, 2000).

Crickenberger and Sojka (2000) identified several disadvantages relating to thermal imaging cameras, such as the firefighter's tendency to move deeper into buildings because of the increased visibility and speed provided by the camera. This increases their time for withdrawal in case something goes wrong. The visibility provided also increases the desire to stand, thereby increasing the amount of heat absorbed by the firefighter. Firefighters that become dependent on the camera can become disoriented and/or lost if the camera fails. If firefighters are not adequately

trained in interpreting what they view, they may make flawed decisions that present hazards to themselves and others.

The heat signature that the camera sees remains as long as the heat remains, thereby creating a phantom image. Roundtable Opinions (2000) describes an incident where during a search and rescue operation, the crew discovered the image of a body and attempted rescue. What they found was nothing. The reason they saw an image was that the camera was reading the heat signature of a person that had already left the structure. Another example of potential concern occurred when a firefighter, seeing heat in a ceiling, directed the crew to pull down that ceiling. Unnecessary damage was done to the structure because the firefighter was seeing a heat buildup, rather than an actual fire.

All thermal imaging cameras depend on electricity to function. The batteries appear to be the weakest link. If the camera goes dead, your only option is to change the batteries, which may or may not solve the problem (Eisner, 2000).

Eisner (2000) further identifies a concern with the camera's effect on the firefighter team concept. The tendency is that the person with the camera has better visibility and may move forward, leaving the rest of the team behind. This creates a serious safety concern for the total crew. Woodworth (1997, March) and Love (1999) sum up the limitations in this way technological limitations with on screen image generation, short battery life, lack of appropriate training and cost.

Many of the TIC's limitations can be mitigated with proper training on how to use the camera. Training is essential to utilizing the cameras to their full extent (Corbin, 1999). Woodworth (2000) explains how astounding it is that many fire departments are

putting TIC's into service with little or no training. In Woodworth (1997, February) he identifies the first objective after buying a thermal imaging device should be to train all personnel in its use. This training should include practice sessions as well as classroom. In Woodworth (2000) he defines this training. He describes training that provides basic information on how to interpret the image, tactics, and safety. He also believes that the training should include live fire portions allowing the trainee to see how fire conditions can change. He explains that not having actual live fire training could prove to be disastrous. Woodworth is not alone in advocating actual hands on training. Crickenberger and Sojka (2000) describe training where the firefighter is taught how to interpret the image and then subject them to a battery failure in a training environment to drive home the point that the camera can fail. Eisner (2000) explains that without an understanding on how the camera works, the crews may not even use it. We must also remember to maintain our traditional search and rescue training because we should not rely on a camera for our orientation or ability to move in a hostile environment (Roundtable Opinions, 2000). It is very important to remember that a thermal imager is just a tool. It is essential to train with it as often as possible and remember to stay in a known position, because if the imager fails the user can fall back on standard techniques (Cook, 2000).

As of yet, there are no training standards for the use of thermal imagers, but as more departments obtain the units, standard operating procedures will be developed (Corbin, 2000).

PROCEDURES

Research Methodology

The research procedures in preparing this paper began with a review of the literature available at the Learning Resource Center at the National Fire Academy in March of 2001. The purpose was to obtain materials and information relating to thermal imaging cameras, their use and training that would assist in the generation of this paper, but would also assist in the production of a questionnaire on the topic. In an effort to stay as current as possible, no literature was utilized that was over ten years old.

A questionnaire pertaining to TIC's was sent by e-mail to eighty-one fire departments from twenty-nine states within the United States on April 25th, 2001. The questionnaire was accompanied by a cover letter explaining who I was and what I was trying to accomplish. See (Appendix A). The questionnaire consisted of eleven questions with both yes and no responses, as well as requests for written examples. The goal was to take a random look at how the fire service's, both large and small, were utilizing this new technology if they had it at all. The questions were specific and inquired about the number of cameras, training requirements, types of cameras, experienced limitations and malfunctions, operational concerns, and situations where the cameras had been beneficial.

Of the eighty-one questionnaires sent out, fifty-two were returned over the next sixty days. The response rate of sixty four percent was acceptable for the purposes of the research. According to Babble (1973), a response rate of 50% is acceptable for analysis reporting, and 60 percent is good. There were several phone calls made to follow-up on information contained in the responses.

Definition of Terms

Emissivity. The ratio of radiation intensity from a surface to the radiation intensity at the same wavelength from a blackbody at the same temperature.

Pyro Electric Vidicon (PEV). A thermal image camera type, usually handheld. This type of camera can be affected by pointing it at direct source emitters causing the whiteout phenomenon. PEV uses tube type construction.

Rapid Intervention Team (RIT). A team of firefighters used for the rescue of other firefighters at an emergency incident.

Thermal Imaging Camera. (TIC). A tool capable of converting infrared heat energy into a viewable real time image.

White-Out. This refers to what happens when a thermal imaging camera is pointed at a very hot object (direct emitter source). This causes the sensor to be overloaded and generates a completely white screen.

Limitations

Several limitations can be identified within this research endeavor. The choice not to utilize any literature on the topic that was over ten years old eliminated information that was available on the subject. That information may have affected the outcome of this paper and the questions used in the questionnaire.

The eighty-one fire departments that were sent the questionnaires did not include all of the fire departments that may have had thermal imaging cameras in operation and therefore not all of the information available was collected.

The information that was collected in the literature review and the questionnaire was only as current and relevant to the time that it was collected. More cameras go into

service every day and are affecting the fire service's experiences with them. Those new experiences may have had an affect on the answers in the questionnaire, on the outcome of this paper, and its recommendations.

RESULTS

The results identified for the following research questions are a culmination of the literature review and fifty-two questionnaires that were returned from twenty-nine states. The detailed results of the questionnaire are provided in Appendix B and a Standard Operating Procedure developed from the research is provided in Appendix C.

Answers to Research Questions

Research Question 1: What limitations are being identified regarding thermal imaging Cameras?

The research of this question from the questionnaire found that of the twenty-seven fire departments that had TIC's in service, they all had experienced both limitations as well as malfunctions in their cameras. The departments reported that they had six battery failures during use, one power module failed and two transmitters failed. The departments also reported limitations in the following areas: ten cameras had experienced white-out situations, nine had experienced reflection problems, five distorted images due to steam and/or water, and four reported of concerns with the available field of view. These types of limitations were also reported in the literature review. Spivak (1999) and Eisner (2000) both reported limitations in use due to the way that the image may be presented and interpreted by the firefighter. The interpretation of the image was also seen as a possible limitation by Roundtable (2000) because the image remains after the item producing the heat is gone. Cogan (1992) and Lyons

(1998) described instances where water and/or its cooling effect distorted the image or made it unclear. One of the largest concerns in the questionnaire was that of reflection of the heat signature, and this was also reported by Corbin (2000). Woodworth (1997), Love (1999) and Eisner (2000) all reported limitations in battery life.

Research Question 2: What training should be required prior to utilizing a thermal imaging camera on an incident?

Of the twenty-seven fire departments that responded to the questionnaire, all but three required some training prior to use of the camera. That training was identified in the following areas: twenty three required training in basic design, maintenance, battery life and search and rescue, nineteen required size-up techniques, thirteen in the dynamic range of the sensor and the camera's field of view, nine required an understanding of the light wave bands, four on how to use the camera in overland search techniques and three on the emissivity ratings of the camera. Of the departments, fifteen were utilizing competency based training programs, and the training ranged between zero to eight hours. Of the eleven departments that had more than one type of camera, four required competency in each type prior to use.

Woodworth (1997) suggests that all personnel be trained and practice in actual practice sessions and further defines that training as being in areas of interpreting the image, tactics and safety. Training was also suggested in simulated sessions where there would be a battery failure (Crickenberger and Sojka, 2000). Cook (2000) and Roundtable Opinions (2000) both speak of training that will remind the firefighter to stay oriented and the need to maintain basic firefighter techniques because cameras do fail.

Research Question 3: Under what conditions are other fire service organizations allowing the use of thermal imaging cameras?

The questionnaire identified that of the twenty-seven departments that had cameras in service there was a great difference in the numbers of cameras. The range was from one to forty seven in service at one time. Of the twenty-seven, sixteen had more than one camera in service at a time. Of the sixteen, thirteen had response procedures that would move a second camera to the scene of an incident. Of those same sixteen, seven departments said they would designate the second camera to their RIT. Of the twenty-seven departments that had cameras in service, only five said they had standard operating procedures in place to control the use and training of the cameras. The cameras in use were identified as being utilized for size-up, hazardous materials, locating hot spots in overhaul, reducing property damage, and search and rescue.

The major areas of use identified in the literature were size-up, fire attack, search and rescue, locating fire extension, command, hazardous materials, water rescue, rapid intervention teams, wildland fires, overhaul and the limit of your imagination (Image Is Everything, May; Cogan, 1992).

DISCUSSION

The research conducted on thermal imaging cameras demonstrates the technology is improving and that the fire service's use of them is increasing. Corbin (2000) described how the first cameras needed to be cryogenically cooled and were too large for the fire service to use. Spivak (1999) described the first cameras, from the 1980's, that used solid state electronics and were small enough and inexpensive

enough for the fire service to utilize. The expansion of this technology throughout the market place has produced numerous suppliers and competition that has pushed the price to between $17,000 and $26,000 depending on options (Image Is Everything, 1998; Can you see Through Smoke, 1998).

With the cameras being sold in these price ranges and the improvements that have been made in the technology, there has been an explosion in the numbers being utilized. Crickenberger and Sojka (2000) estimate that there will be over 100,000 cameras in use within the next few years. This increase can also be attributed to the positive benefits being reported from those that have cameras. Kosiarski (1993), Lyons and Parmenter (1995), Siuru (1996), Hartin (1997), Colley (1999), Imager Saves Firefighters (1999), Richardson and Scholer (1999), Thermal Imaging Cameras (2000), and many others are describing situations where a firefighter's job becomes safer and their efforts more productive because of the cameras. There can be no doubt that a fire department with thermal imaging cameras has a greater potential to identify danger areas on the incident scene and locate victims. This research further identified why this technology is important and needed by my organization.

For all of a camera's benefits, there are also some concerns. There are numerous manufacture's, options, buttons, switches, batteries and views that can be purchased, and all of these have specific limitations associated with them. There are no regulations or standards currently adopted for their use or manufacture (Eisner, 2000). Both Spivak (1999) and Eisner (2000) describe what they consider to be limitations due to the differences in cameras and how they present the image. Cogan (1992) and Lyons (1998) both give examples of how water can distort the image. The fact that the

cameras run on batteries cannot be overlooked either. Eisner (2000), Woodworth (1997, March) and Love (1999) all speak to the concern of battery failure and the effects it could have on the personnel using it. The responses from the questionnaire also echoed many of these same limitations and concerns.

Most of these limitations and concerns can be addressed with a good training program. None of the authors or anyone responding to the questionnaires ever suggested sending a camera back. They understood the benefits. They did express concerns on reliability and the need to understand what the cameras could and could not accomplish. Woodworth (2000) expressed his amazement on how many fire departments put cameras into service with little or no training. With all of the potential uses on the incident scene, it became apparent that to be an effective tool there needed to be some in-depth training. With no standards set, it comes down to the individual department as to what training they will do. From the questionnaire there were actually three departments that stated they required no training prior to a camera's use. However, the recognition that training is necessary is being widely reported. Most of the current literature, Woodworth (2000), Crickenberger and Sojka (2000), Eisner (2000), Cook (2000) and Roundtable Opinions (2000) are all speaking to the issue that training is very necessary. Many of them relate potential situations where because of the camera, crews can move faster, go deeper and potentially become dependant on the camera for their safety and orientation. Training and relying on basic firefighting and search skills is identified as being vitally important.

Roundtable Opinions (2000) explained that with good standard operating guidelines a thermal imaging camera will make a difference in any fire service

organization. The literature research and questionnaire both showed the potential benefits of cameras and some concerns. The information from the questionnaire demonstrated departments are moving more than one camera to the scene and many are assigning the second camera to their RIT. My organization, when it gets this technology, needs to understand the camera's benefits, its limitations, the need to train its personnel, and control the camera's use.

RECOMMENDATIONS

The problem for the SVFD was while it was in the process of acquiring thermal imaging cameras it did not have a Standard Operating Guide for their training or use on the incident scene. The purpose of this research paper was to develop that SOG.

The information collected from the literature review and from the questionnaire was used to develop the following recommendations for the SVFD's SOG.

1. All personnel, prior to the use of a thermal imaging camera, shall complete and demonstrate competency as defined within the department's thermal imaging training program.
2. Personnel may only use the make and model of cameras they have been trained to use.
3. The use of thermal imaging cameras inside a structure shall be approved by the incident commander.
4. The priority of thermal imaging camera's use on an incident shall be, (1) the first camera on scene is available for any use, (2) the second camera shall be assigned to RIT, (3) the third or any additional cameras on scene are available for any use.

The benefits of these recommendations and the SOG produced are to provide for the safe use of thermal imaging cameras within the SVFD. It is also to provide for their availability on the incident scene. My recommendations for future readers are to use this information to produce their own SOG, and consider how the numbers of cameras and the size and configuration of your department will effect some of the components.

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APPENDIX A

Spokane Valley *Fire Department*

Thermal Imaging Camera Questionnaire

To: Fire Department Name

From: Larry T. Rider
Assistant Chief
E. 10319 Sprague
Spokane, WA 99206
RiderL@Spokanevalleyfire.com

Date: 4/25/2001

Hello, I am doing research on thermal imaging cameras and their standard operating procedures. With the huge increase in the number of cameras in service today I am very interested in how your organization is training, utilizing and any problems that you have encountered with this new technology. I am also interested in any concerns that you have about their use!

Firefighter safety is a goal that we all share. This new technology offers many opportunities to improve search, size-up and our safety in many ways. I am doing this research because of a concern that without effective control, training and experience some of our firefighters may become overly dependent on a tool that has the potential to fail or mislead.

Please take the time to answer the following questions and then e-mail them back to me. If you have a thermal-imaging camera SOP, please send it along if possible or mail me a copy. I know that this takes time, but I would really appreciate it!

If I can be of assistance to you, give me a call.

Thanks, Larry T. Rider

1. Do you have a thermal imaging camera in service within your organization?
If yes, how many?

2. Do you currently have a standard operating guideline for its use?
If so, please e-mail or send me a copy.

3. Do you require any of the following training or demonstrated competencies prior to the camera's use?

Basic design
Light wave bands
Dynamic range of sensor

Emissivity setting of camera
Camera's field of view
Maintenance and battery life
Size-up techniques and examples
Search and rescue techniques and examples
Overland search techniques and examples

4. How many hours of training are required?

5. Is your training competency based?

6. Do you have more than one brand or style of camera in use?

If yes, what brands?

If yes, do you require training with each type prior to its use?

7. If you have more than one camera, do you dispatch a second camera to the scene?

Where do you assign it?

Entry Team / RIT / back-up Team / Other

8. Have you identified any limitations with your cameras?

White-Out?

Battery failure during use?

Reflection problems?

Other?

9. Are you having any malfunction problems with your camera?

Please list?

10. Are you experiencing instances where your crews are venturing deeper into structures than expected because of the camera? Please list examples.

11. Do you know of situations where you have used the camera with success?

Please list.

APPENDIX B

Thermal Imaging Camera Questionnaire Results

Eighty-one questionnaires were sent and fifty-two were returned.

1. Do you have a thermal imaging camera in service within your organization?
Twenty-seven departments had cameras in service.
If yes, how many?
The range was from one to forty-five cameras.

2. Do you currently have a standard operating guideline for its use?
Five of the twenty-seven departments had standard operating guidelines in place.

3. Do you require any of the following training or demonstrated competencies prior to the camera's use?

Basic design	**23**
Light wave bands	**9**
Dynamic range of sensor	**13**
Emissivity setting of camera	**3**
Camera's field of view	**13**
Maintenance and battery life	**23**
Size-up techniques and examples	**19**
Search and rescue techniques and examples	**23**
Overland search techniques and examples	**4**

Three of the twenty-seven departments required no training prior to a camera's use.

4. How many hours of training are required?
The range was from zero to eight hours of required training.

5. Is your training competency based?
Fifteen of twenty-seven departments utilize competency-based training.

6. Do you have more than one brand or style of camera in use?
Eleven of twenty-seven departments had more than one brand of camera.

If yes, what brands?
TI, Bullard, Cairns, ISI, MSA, Argus, Flur, Scott, Fire Research

If yes, do you require training with each type prior to its use?
Of the eleven, four required training on both brands.

7. If you have more than one camera, do you dispatch a second camera to the scene?

Of the sixteen departments that had multiple cameras only three did not have response procedures that moved a second camera to the scene.

Where do you assign it?

Of the sixteen, seven designate the second camera to be with RIT.

8. Have you identified any limitations with your cameras?

White-Out?	**10**
Battery failure during use?	**6**
Reflection problems?	**9**
Other?	**Distortion due to steam – 5** **Field of view – 4**

9. Are you having any malfunction problems with your camera?

Transmitters - 2, Power Modules - 1,

10. Are you experiencing instances where your crews are venturing deeper into structures than expected because of the camera?

Four departments expressed the possibility that their crews may be venturing deeper into structures than they may have without a camera.

11. Do you know of situations where you have used the camera with success?

Twenty-three of the departments identified situations where the cameras saved time and property involving size-up, haz-mat, locating hot spots, reduced property damage and one life saved.

APPENDIX C

SPOKANE VALLEY FIRE DEPARTMENT

SAFETY & OPERATIONS MANUAL

Thermal Imaging Camera (#455) Page: 1 of 1

Adopted: 07/12/01

Person Responsible: Assistant Chief Revised: 07/12/01

Policy:
The Department recognizes the many benefits of thermal imaging technology including identifying life hazards and evaluating fireground conditions and will provide that technology, as resources are available.

Outcomes:
The following procedures are designed to provide for the availability of thermal imaging on the incident scene and its safe operation.

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I. Thermal Imaging Cameras

A. The district's thermal imaging cameras will be carried and maintained by the crews on the following apparatus, Valley 20, Engine-5 and Rescue-1.

B. All personnel, prior to the use of a thermal imaging camera, shall complete and demonstrate competency as defined within the department's thermal imaging training program. Personnel may only use the make and model of cameras that they have been trained to use.

C. The use of thermal imaging cameras inside a structure shall be approved by the incident commander.

D. The priority of thermal imaging camera use on an incident shall be, (1) the first camera on scene is available for any use, (2) the second camera shall be assigned to RIT, (3) the third or any additional cameras on scene are available for any use.