NFPA 1033 List of 16 Part 4: Understanding Topics 13 to 16

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This submission of the "FISC Bulletin Board" will address the final four topics listed in NFPA 1033, Section 1.3.7. The first three articles in this series were published in the January 2018, April 2018 and October 2018 editions of the F&AI Journal. They are available to IAAI members on the IAAI website at this URL:

https://www.firearson.com/Publications-Resources/Fire-Arson-Investigation-Journal/Default.aspx (sign in required).

The intent of the Fire Investigator Standards Committee (FISC) is to provide the reader with resources to gain the requisite knowledge, and the ability to better articulate that knowledge, of the topics listed in NFPA 1033 Section 1.3.7 "beyond the high school level." Any opinions expressed in this series are those of the FISC and do not necessarily reflect the opinions of the National Fire Protection Association, the NFPA Technical Committee on Fire Investigations, the NFPA Technical Committee on Fire Investigator Professional Qualifications or the International Association of Arson Investigators, Inc.

NFPA 1033, as a Standard, requires that "The fire investigator shall remain current in the topics listed in section 1.3.7 by attending formal education courses, workshops and seminars and/or through professional publication and journals".[1] A competent fire investigator must be able to properly apply their knowledge, explain how that knowledge was applied to a set of facts (or to hypothetical situations), and articulate their work in a litigation setting. With that in mind, let us continue with discussion on topics 13-16.

(13) Failure analysis and analytical tools

(14) Fire protection systems

(15) Evidence documentation, collection, and preservation

(16) Electricity and electrical systems

Failure Analysis and Analytical Tools

NFPA 1033 states in Section 4.1.2 that the Scientific Method is the "…operating analytical process…" that will be used in all fire investigations.[2] The Scientific Method requires an analysis of all data that has been collected. The fire investigator must have a basic knowledge of the systems and tools used to organize and evaluate the information collected during the investigation.[3]

Chapter 22 of NFPA 921. "Failure Analysis and Analytical Tools", provides much of this information. The investigator must be able to document, in a report outlining an expert opinion, that a systematic, scientifically valid approach was used in the evaluation of investigative data. This chapter provides an explanation of analytical approaches that range from simple (i.e. time lines, flow charts and fault trees) to the very complex and specialized (i.e. mathematical modelling, engineering analysis live fire testing).[4]

The challenge for the fire investigator is to know the parameters and limitations of these various tools, and to understand their appropriate use and potential misuse.[5] These systems can only be used to evaluate the data provided by the investigator. Incomplete data, manipulation of data or choice of an inappropriate analytical tool can yield results that may be contradictory to the actual origin and cause. Care should be taken to ensure that the investigator has his analytical work reviewed by others to ensure data integrity. NFPA 921, Section 4.6 describes the different types of reviews the fire investigator's work might undergo and highlights the limitations of those reviews.[6]

There are several CFI Trainer modules that can provide comprehensive instruction on the selection and use of various analytical tools. These include; "The Scientific Method for Fire and Explosion Investigations", "Fire Dynamics Calculation, Version 2.0", "Introduction to Fire Dynamics and Modelling" and "Using Resources to Validate your Hypothesis".

Fire protection systems

Webster's defines fire protection as the; "measures and practices for preventing or reducing injury and loss of life or property by fire."[7] Of particular interest to fire investigators, is the information that comes from the systems that provide for this protection. This data comes in two forms; the post-fire examination of the system and an engineering and scientific evaluation of the system's performance during the fire incident. It is, of course, essential that the investigator recover this information in their efforts to determine the origin and cause of the fire. The types of systems that the fire investigator must evaluate include; active fire protection systems (e.g., fire detection and suppression systems) as described in chapter 8 of NFPA 921 and passive fire protection systems (i.e. systems that are an integral part of the fire building and do not utilize electrically or mechanically controlled moving parts).

A systematic approach must be used in collecting this data, beginning first by establishing if the system activated during the fire incident. This seemingly simple question can be difficult to answer.[8] Typically, the local fire marshal and building code officials may also be of particular use in identifying the presence and operation of fire protection systems. Likewise, interviews of first responders or building occupants will yield this data.

Once the presence of fire protection systems is established, the investigator must identify: which device(s) activated, and what type of device it is. Fire protection systems can be quite complex. The fire investigator should not be hesitant to consult with other subject matter experts who are familiar with the post-fire, forensic examination and evaluation of fire protection systems in order to assist with this data collection.

Evidence preservation is key to the successful evaluation of a fire protection system's operation and effectiveness. Care should be taken during the fire investigator's initial scene inspection to thoroughly document each component of the system(s), preserve the position of controls, switches and valves, preserve the location of the system's components, as well as to ensure that any digital data that may be stored on addressable media be forensically preserved and collected. Since service/testing records may also play a vital role in an investigation, these documents should also be secured during the fire scene examination. Finally, the investigator should contact the company who "monitors" the system and request information about the event. (NOTE: Such information is often considered proprietery and will only be released to the "client".) This information will help establish an accurate timeline of the progression of the fire, as is described in the 2017 edition of NFPA 921.[9]

As it is plain to see, information from these fire protection systems can be vital to the fire investigation. When the time comes to remove the components (from the debris), the investigator should ensure that all interested parties have been placed on notice of the inspection. The process of examining and collecting fire protection systems during a fire scene examination should be well documented. Just like other evidentiary items, a chain of custody should be kept for each component of the system. Remembering that information from these fire protection systems can be of critical importance, as its data may ultimately validate the origin and cause of the fire.

A wealth of information regarding the identification and operation of all types of fire protection systems can be found in the National Fire Protection Association's *Fire Protection Handbook* and the *Fire Protection Systems: Inspection, Test & Maintenance Manual, 4th edition.* Information relative to fire protection systems' importance to the fire investigation can be found in NFPA 921 Sec. 7.6 "Impact of Passive Fire Protection Systems on Investigation" and Chapter 8, "Active Fire Protection Systems". A complete discussion of how fire protection systems can be used to further the fire investigation is found in the CFI Trainer module, "Fire Protection Systems".

Evidence Documentation, Collection and Preservation

Physical evidence is defined generally in NFPA 921 as "…any physical or tangible item that tends to prove or disprove a particular fact or issue." [10] Physical evidence is vital to the fire investigation, as it will serve to support the fire investigator's opinions as to origin, causation, spread issues or the responsibility for the fire's initiation. However, it is important to understand that evidence that is not successfully documented, collected and preserved, would be spoiled and its value to the investigation would be greatly diminished.[11]

The fire scene should be undisturbed as much as possible to facilitate the evidence identification and preservation process. Consideration should be given to both criminal and civil evidence. The fire investigator can minimize risk to the physical evidence by participating in fire department training to instruct fire suppression forces in evidence recognition and preservation techniques. Overhaul operations at the fire scene can also be observed and directed by the fire investigator so as to preserve any physical evidence located in the debris.

Once the evidence has been identified and protected from damage, it is imperative that it is properly documented before it is moved. In order to begin the chain of custody, the investigator must show the original location and condition of the evidence. The method of documenting the evidence will include; field notes, sketches/diagrams, photography and written reports.[12]

The types, form and condition of evidence located at a fire scene is quite varied. The chosen method to collect such evidence must serve two purposes; the evidence must be collected in a manner that the evidence can be safely and securely removed from the fire scene. The evidence must also be packaged so that it can be transported to a lab or storage facility. Since the evidence may be examined multiple times prior to its appearance in a courtroom, the chosen collection method must also be appropriate for long term storage and preservation. Section 17.5.4 discusses several methods to collect and preserve various types of fire scene evidence.

The fire investigator must ensure that the evidence is continuously accounted for from the time it is collected at the fire scene until its use in a courtroom or its final disposition. This is known as the chain of custody. This will require its storage in a secure facility with strictly controlled access. Each time the evidence is passed from one person to another, that movement must be documented formally on the chain of custody form.[13] The chain of custody form is a permanent record that will be an important document in the investigative file.

A detailed discussion of the process of documenting, collecting and preserving physical evidence at the fire scene can be found in NFPA 921, Chapter 17, "Physical Evidence". Further detailed information can be found in the following modules from CFITrainer.net: "Introduction to Evidence", "Physical Evidence at the Fire Scene" and ""Evidence Examination: What Happens at the Lab?" In addition, the fire investigator should refer to the four (4) American Society for Testing and Materials (ASTM) standards listed in NFPA 921, Section A.17.5.1.2 for information on evidence documentation, collection and preservation methods.

Electricity and Electrical Systems

The final topic on the list of requisite knowledge for fire investigators is arguably the most important; Electricity and Electrical Systems. NFPA 921 devotes Chapter 9 entirely to the analysis of electrical systems and equipment. Specifically, this chapter discusses 120/240 volt single phase systems,

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as they are the systems most commonly found in residential and commercial structures. However, the basic electrical theory discussed pertains to all electrical systems.

Three fundamental points are emphasized in the very early part of NFPA 921 Chapter 9. They form the foundation for how the analysis of electricity and how it relates to the origin and cause of fire should be handled. First, Chapter 9 stresses that it is imperative the origin and the fire be properly determined.[14] Secondly, the text states that the mere presence of electrical components within the area of origin should not bias the fire investigator towards an electrically caused fire, as electrical equipment should be considered equally as a fire cause along with all other potential sources of ignition found in the area of origin. Lastly, there is a statement that a properly installed and maintained electrical system does not normally present of hazard of ignition.[15] These three points are to be heeded by the fire investigator on every fire scene investigation in order to maintain consistency with the scientific method.

NFPA 921 Chapter 9 also discusses the proper methodology for conducting inspections of fire damaged electrical systems, commonly found conditions at the fire scene and the proper procedure for conducting an arc mapping survey. These are skills that are needed on almost every fire scene, as every conceivable type of occupancy or equipment encountered in a fire investigation will have some type of electrical system.

The fire investigator will need to have a working knowledge of both basic electrical theory, proper nomenclature and the basic operation of commonly-found electrical components. This information is provided in NFPA 921 Chapter 9. However, the fire investigator must remember that NFPA 921 and NFPA 1033 both allow, and even encourage, the use of additional resources and experts in order to properly conduct a thorough and complete investigation.[16,17] In fact, most fire investigators will be well-experienced in working alongside electrical engineers during the fire scene inspection and subsequent evidence examination process.

Although NFPA 921 provides the basic level of knowledge needed by the fire investigator to conduct inspections and analyses of fire damaged electrical systems, there are many more resources that the fire investigator may use to increase their knowledge and proficiency. The NFPA provides aids to the National Electrical Code that many investigators will find helpful. These include, the Electrical Inspection Manual and the Pocket Guide to Residential Electrical Installations. CFI Trainer provides a total of 5 modules devoted almost entirely to the different aspects of electrical system evaluation. These are; “Arc Mapping Basics”, “Basic Electricity”, “Electrical Safety”, “Motor Vehicle Fires: the Engine and the Ignition, Electrical and Fuel Systems” and “Residential Electrical Systems”.

Conclusion

The Fire Investigation Standards Committee hopes that you have enjoyed this four-part series and have found it useful. We certainly encourage you to continue your career development by constantly seeking to improve your knowledge and skills, and by receiving proper acknowledgement of your achievements by seeking the appropriate certifications and designations. Remember, by improving your own skills, you are helping to raise the bar for the entire fire investigation community.

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