This document sets forth background materials on the scientific research supporting examinations as conducted by the forensic laboratories at the Department of Justice. It also includes a discussion of significant policy matters. This document is provided to assist a public review and comment process of the related Proposed Uniform Language for Testimony and Reports (posted separately). It is not intended to, does not, and may not be relied upon to create any rights, substantive or procedural, enforceable by law by any party in any matter, civil or criminal, nor does it place any limitation on otherwise lawful investigative and litigative prerogatives of the Department.

SUPPORTING DOCUMENTATION FOR DEPARTMENT OF JUSTICE PROPOSED UNIFORM LANGUAGE FOR TESTIMONY AND REPORTS FOR THE FORENSIC EXPLOSIVES AND HAZARDOUS DEVICES DISCIPLINE

Background

No definitive history exists on the discipline of hazardous device examinations. Some general principles utilized in the discipline can be found as early as 1887 in testimonies proffered by experts in the Haymarket Square Riot in Chicago.[1] The need to identify the characteristics of bombs pre-dates the FBI's examination of hazardous device evidence. Major cases requiring such analyses harken back to bombings such as the Los Angeles Times building attack in 1910.[2] During these early cases bombing forensics was conducted by a variety of independent entities, using non-standard techniques under the auspices of general investigations. It is unclear how the FBI developed the hazardous devices discipline. The earliest documented publication released by the FBI on bombs and explosives dates back to 1941.[3] Whereas the focus of the publication is mostly on safely dealing with an explosive device, limited advice on preservation of evidence for later analysis is provided. In 1968, Congress passed the Crime Control Act[4] and the Gun Control Act,[5] which first introduced "destructive devices" under the definition of firearm, including an "explosive bomb" as a type of destructive device.[6] With the advent of this act and the evolution of bombing campaigns, spawned as part of the protests to the Vietnam War, the discipline of Hazardous Device examination matured and became a specialty in a small sub-set of laboratories. To date, only three major federal laboratories practice Hazardous Device examinations. These are housed in the FBI, the ATF and the United States Postal Service. As this forensic discipline is so specialized, no governing body exists that accredits either its practitioners or its application by forensic laboratories. Despite the lack of official accreditation,

[1] *Illinois v. August Spies et al.*, 12 N.E. Rep. 865 (1886). Stemming from an incident commonly referred to as the Haymarket Affair (May 4, 1886) in which a bomb killed a police officer and wounded several others triggered an exchange of gunfire between law enforcement and a crowd killing a total of 11 individuals and wounding 120. Appealed to the Illinois Supreme Court (122 Ill 1 (1987)); *Spies v. Illinois*, 123 U.S. 131, cert denied (1887).

[2] Irwin, Lew, *Deadly Times*, Globe Pequot Press, Guilford, CT, 2013.

[3] Federal Bureau of Investigation, *Bombs and Explosives*, April 1941.

[4] Omnibus Crime Control and Safe Streets Act (Crime Control Act) of 1968, Pub. L. No. 90-351, § 802, 82 Stat. 197, 212-23.

[5] Gun Control Act of 1968, Pub. L. No. 90-618, 82 Stat. 1213 (codified in scattered sections of 18 U.S.C. and 26 U.S.C.)

[6] 26 U.S.C. § 5845(f) and 18 U.S.C. § 921(a)(4), 2013.

the FBI Laboratory Explosives Unit has created rigorous protocols for all of its examinations involving Explosives and Hazardous Devices. These protocols have been developed by scientists recognized world-wide as experts in the field of explosives. In addition, these protocols have been reviewed by international organizations that also specialize in the field of Hazardous Device examinations. Most importantly, these protocols have withstood the scrutiny of the legal system throughout the highest profile bombing cases prosecuted in the United States. Examples of such cases include the World Trade Center Bombing (1993), the Oklahoma City Bombing (1995), the Centennial Park Olympic Bombing (1996), the African Embassy Bombings (1998), the Shoe Bomber (2001), the Underwear Bomber (2009), and, most recently, the bombing attack on the Boston Marathon (2013).

Principle of Forensic Explosives and Hazardous Devices Examination

Explosives and hazardous devices examination is a forensic discipline based on the premise that physical evidence from the scene of a bombing includes the damaged components of the bomb itself. Explosives and hazardous devices examinations have the primary objective of identifying the physical components of IEDs and determining the role of those components in the functioning of the device. The underlying premise of component identification posits that under certain circumstances, the explosion of the bomb itself, although incredibly energetic and destructive, may leave behind components used in the IED that retain identifiable characteristics. Should enough of these observable, physical characteristics be present, either a recognition (determination that a specimen fits into a broad class of items such as wire, batteries, switches) or identification (determination that a specimen meets the criteria to be labeled as a specific item within a broader class of items, such as an Eveready brand 9 V battery, or Intermatic brand switch) of the components may be affected and their role in the functioning of the bomb determined.[7]

Depending on the construction of the IED, the high pressures and temperatures generated during the explosion may leave few, if any, observable, physical characteristics on the IED components, thereby rendering recognition or identification impossible. This does not necessarily preclude, however, a determination that the explosion was caused by an explosive device. The explosion process itself can leave behind physical signatures that may be used to infer that an explosive device caused the observed damage. For example, the detonation of certain types of explosives, referred to as high explosives, can leave signatures on objects in the near vicinity of the explosion, including, but not limited to, the presence of embedded soot, or a distinct discoloration and the presence of knife-like edges on metallic surfaces.[8]

Explosives and Hazardous Devices Examination Process

There are different methodologies and processes for conducting a forensic explosives and hazardous devices examination. The Department shares information regarding some appropriate

[7] Thurman, James T., *Practical Bomb Scene Investigation*, CRC Press, Boca Raton, 2011, pp. 117.

[8] Tardiff, H.P., Sterling, T.S., Explosively Produced Fractures and Fragments in Forensic Investigations, J. Forensic Sci., 1967, 12 (1), 247-272.

processes below. The Department does not suggest that the processes outlined here are the only valid or appropriate processes.

The explosives units within the Department's Laboratories conduct the analysis of explosives and hazardous devices examinations. The challenge for explosives and hazardous devices examiners is to isolate the damaged, and often fragmented, components of the IED from the bulk of the evidence that often includes debris from surroundings not associated with the components themselves. The ingenuity of the IED designer further complicates matters since it directly affects the overall IED design and construction. An innumerable quantity of commercially-available, as well as homemade, components could be utilized in the IED construction process and used in numerous ways.

A common process of explosives and hazardous devices examination consists of five steps: component segregation, component recognition, component identification, function determination, and comparison.[9] These steps are described in detail below. It is important to note that the tremendous forces and temperatures present during an explosion impose an inherent limitation on the examination process; some of the IED components may be so severely damaged that they may be unidentifiable, therefore it may not be possible to complete every step of the examination process. As articulated in a 2009 National Academy of Sciences (NAS) report, "the very nature of an explosion has a direct impact on the quality of evidence recovered. Pristine devices or device fragments, or appreciable amounts of unconsumed explosive material, should not be expected."[10]

A. Component Segregation

IEDs can be constructed from numerous commercially-available, or homemade, items. The first step in the examination of a suspected device is the segregation of potentially relevant items that may be present in the evidence. Often items submitted as evidence to the Laboratory as part of a bombing investigation were not part of the IED and may consist of background debris from the bombing scene. The segregation process involves the separation of items of potential forensic value for further examinations by Explosives Unit personnel or forensic examiners from the other Laboratory disciplines. Each item is photographed to depict the condition in which the evidence was received. Photographing bombing evidence in its original condition is extremely important during this step because the evidence may be altered during subsequent forensic examinations. For example, tape used to connect electrical components in an IED will have to be removed for forensic examinations by other disciplines, thus altering the original condition of the evidence. Preserving the original condition of the evidence through photography may prove crucial during the latter stages of examination by an explosives and hazardous devices examiner attempting to reconstruct the device. Also, to best preserve forensic evidence of value, consultation with examiners in other Laboratory units is made on a case-by-case basis to determine whether specific items should be photographed before or after their examination as well as to determine the proper order of examinations to preserve such evidence. For example, layers of tape used to connect various components of an IED should not be removed before a

[9] Explosives Unit Device Examinations Standard Operating Procedure (SOP), Issue Date: 07/07/06, Revision 0.

[10] Strengthening Forensic Science in the United States: A Path Forward, National Research Council, National Academies Press, Washington, DC, 2009, http://www.nap.edu/catalog/12589.html, pp. 170.

latent fingerprint examination is performed on the surface of the tape, otherwise a potential latent fingerprint on the overlapping layers may be compromised.

B. Component Recognition

All IEDs require, at a minimum, an explosive and a method that causes this material to explode. The explosive is referred to as the explosive main charge and the method causing the main charge to explode is referred to as the initiating, or fuzing, system.[11] Initiating systems are further categorized as being either non-electric or electric. For example, anything that can undergo combustion or create sufficient thermal output to induce chemical decomposition in a heat sensitive energetic material can potentially serve as a non-electric, initiating system. Electric initiating systems tend to be more complex, usually requiring multiple electrical components such as batteries, wire, and switches.

The recognition step involves visual examination of the segregated items in an attempt to assign general attributes, or class characteristics, to items that could potentially function as parts of the initiating system. As an example, consider Figures 1 – 4 which depict some of the remnants from the explosion of an IED consisting of a briefcase containing a metallic pipe full of explosive, referred to as a pipe bomb, and various components. The components depicted in Figures 1 - 2 and 3 – 4 bear the observable, physical characteristics of portions of an electrical timer and the body of a switch, respectively. That is, the observable, physical characteristics have been *associated* with a timer and the body of a switch. Once class characteristics are assigned to as many items as possible, they are taken to the next step of the process for a more thorough forensic analysis in an attempt to identify them.

Figure 1. Damaged remnants from the explosion of an IED that are visually consistent with the internal components of an electrical timer.

Figure 2. Damaged remnants from the explosion of an IED that are visually consistent with the body of an electrical timer.

[11] Thurman, James T., *Practical Bomb Scene Investigation*, CRC Press, Boca Raton, 2011, pp. 123.

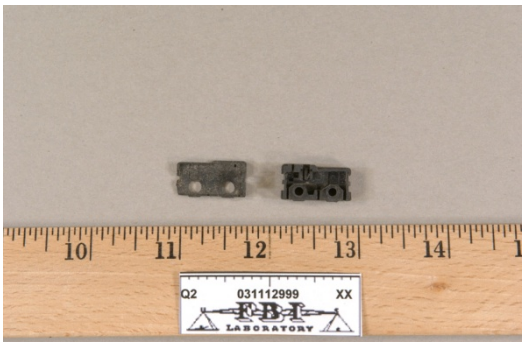

Figure 3. Damaged remnants from the explosion of an IED that are visually consistent with the body of a switch (inside view).

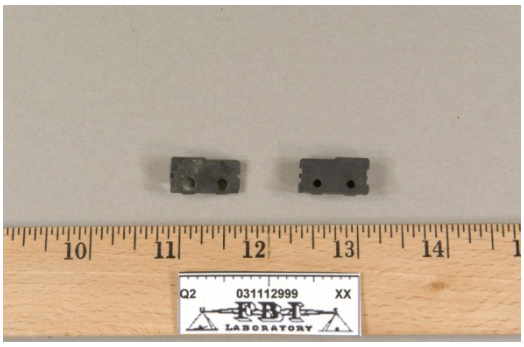

Figure 4. Damaged remnants from the explosion of an IED that are visually consistent with the body of a switch (outside view).

C. Component Identification

The concept of identification utilized in explosives and hazardous devices examinations is not used to designate a sole source of the item's origin. Further, *the use of the term does not imply that the item's origin is linked to a specific individual*. The term *identification* is used in the explosives and hazardous devices examinations discipline to designate the types of IED components that are present in the evidence and their potential manufacturing sources. Returning to the previous example, the items in Figures 1 - 2 were visually compared to reference exemplars and were associated with the components of an electrical timer. In addition, the observable, physical characteristics of the block-lettering "F 60" on a portion of the body of the timer in Figure 2 led to the *identification* of the timer as a commercial, Intermatic™, Model FF60, 60-minute electrical timer sold through various home improvement stores. The items in Figures 3 – 4 were visually compared to reference exemplars and were associated with the body of a lever-type switch. Furthermore, the observable, physical characteristics of the block-lettering "Zippy" and "SM-G" on the body of the switch in Figures 3 – 4 led to the *identification* of the switch as a commercial, lever-type switch manufactured by the Zippy™ Technology Corporation in Taiwan and sold through various electronic supply stores. See Figures 5 – 8 for identification comparisons of the items in question.

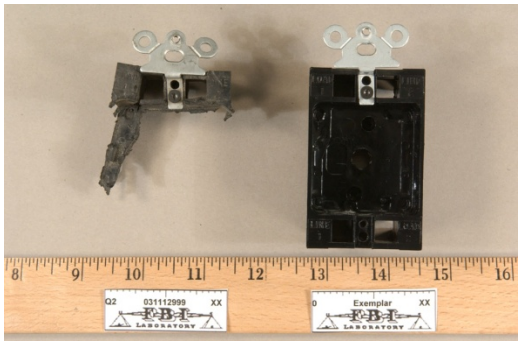

Figure 5. Visual comparison of the damaged body of an electrical timer from the explosion of an IED (left) to an exemplar timer body from a commercial, Intermatic™, 60-minute, electrical timer (right).

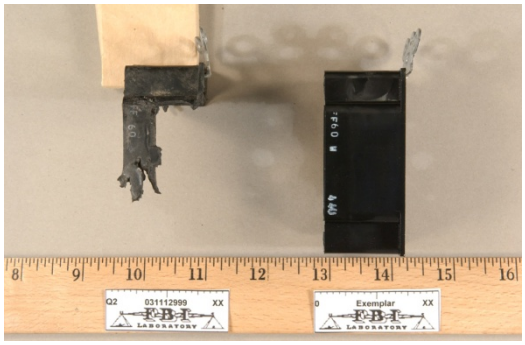

Figure 6. Visual comparison of the damaged body of an electrical timer from the explosion of an IED (left) to an exemplar timer body from a commercial, Intermatic™, 60-minute, electrical timer (right). Note the white, block- lettering "F 60" on both items.

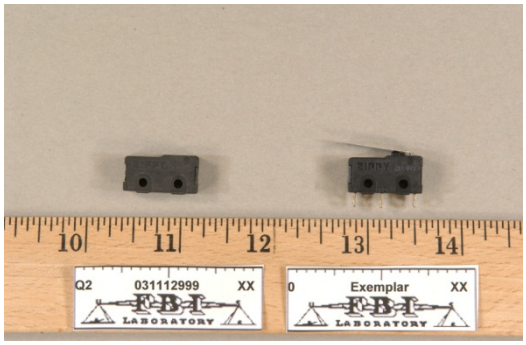

Figure 7. Visual comparison of the damaged body of a switch from the explosion of an IED (left) to an exemplar switch manufactured by Zippy™ Technology Corporation (right).

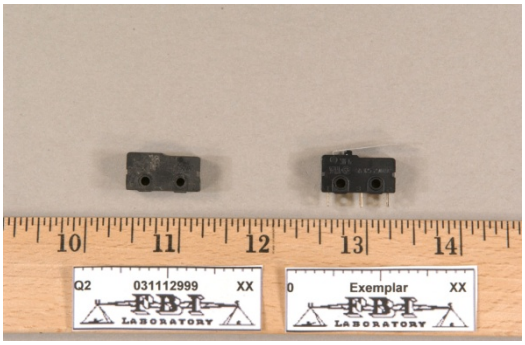

Figure 8. Visual comparison of the damaged body of a switch from the explosion of an IED (left) to an exemplar switch manufactured by Zippy™ Technology Corporation (right).

The process of component identification requires visual, also referred to as macroscopic, analysis of a constellation of observable physical characteristics (such as color, material construction, dimensional parameters, distinct markings etc). In addition to macroscopic examinations, characteristics may also be determined through the use of microscopy. Physical characteristics may also be examined through measurements, including, but not limited to, parameters such as length, diameter, width, and thickness. Tools used to assist the explosives and hazardous devices examiner in conducting these measurements include items such as rulers, micrometers, calipers, and various gauges. Physical measurements are utilized to determine the dimensional value of technical parameters that may be relevant to the identification of a particular component and in determining its possible commercial manufacturing source.

D. Function Determination

Once all of the components have been identified to their fullest extent, attempts to determine their role in the functioning of the IED are made. It is emphasized again in this step that the destruction created by the forces from the explosion of an IED may render a definitive determination of how it functioned impossible. The explosives and hazardous devices examiner may be limited to only logical conjecture on the role of the components in the functioning of the IED, as well as exactly how the IED might have been constructed and functioned as a whole. The explosives and hazardous devices examiner must utilize his/her education, training, and experience to deduce the most logical functioning of the device.

E. Comparison Examinations

There are two general types of comparison examinations that occur in the discipline of explosives and hazardous devices examinations: IED/known origin comparisons (between the components of an IED and items of known origin), and inter-device comparisons (comparison examinations between the components of multiple IEDs). In both examinations, comparisons are made between the observable, physical characteristics of various items to determine if they are similar with respect to those characteristics. These types of examinations may involve comparison of observable characteristics such as shapes, colors, or markings on the components. The examinations may also involve comparison of measured physical characteristics such as length, diameter, width, and thickness of the components.

IED/Known Origin Comparisons

In this case, comparisons between the components of an IED and items of known origin are conducted. A common example of such a case would be a comparison examination between the recovered constituents of an exploded IED and components recovered from the search of a suspect's residence.

Inter-Device Comparisons

In this case, comparison examinations between the components of multiple IEDs are conducted, as well as a comparison of their respective functioning. This type of examination often occurs in serial bombings where the purpose of the investigation is to determine if the IEDs are linked through common design and construction methods. For example, Figure 9 depicts various homemade switches that were visually consistent between multiple IEDs constructed by The Unabomber, Ted Kaczynski.

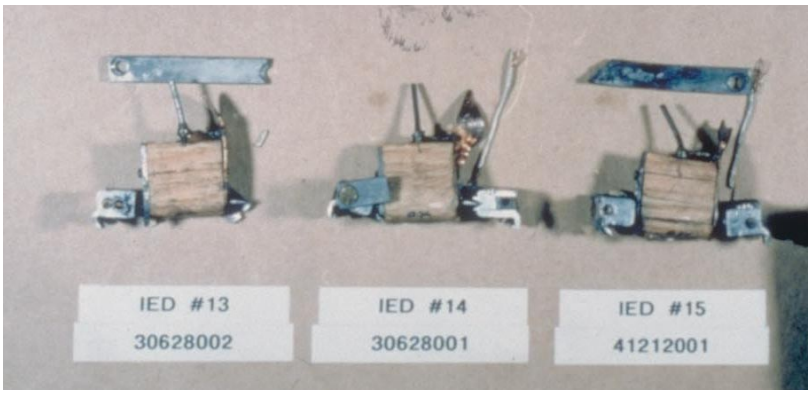

Figure 9. Comparison of similar, homemade switches from different IEDS constructed by The Unabomber, Ted Kaczynski.

Policy Considerations

In 2006, Congress authorized the National Academy of Sciences (NAS) to conduct a study on forensic science, which culminated in a 2009 report.[12] The NAS committee determined that there was minimal concern relating to the discipline of explosives and hazardous devices examinations, stating that "As part of the laboratory work, an analyst often will try to reconstruct the bomb, which introduces procedural complications, but not scientific ones."[13] The NAS found no issues with respect to the reporting or testimony of explosives and hazardous devices examiners, and the report did not affect the way that best practices and standard operating procedures are used in the discipline.

[12] Strengthening Forensic Science in the United States: A Path Forward, National Research Council, National Academies Press, Washington, DC, 2009, (http://www.nap.edu/catalog/12589.html).

[13] *Id.* at 172.