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OSAC Releases its Strategic Vision for Fire Investigations

1. Introduction[1]

In July 2021 the Organization of Scientific Area Committees (OSAC) for Forensic Science released its landmark report, *Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward (the Strategic Vision Report*).[2] This 150-page document is a comprehensive plan for the future of fire investigations.

Beginning with the history of the field, the report then describes the current practice of fire investigations and its relationship with the justice system in the U.S. The report culminates with far-reaching recommendations needed to advance fire investigations as a forensic discipline. Although the legal aspects of fire investigations that it addresses relate primarily to the American experience, the report as a whole has vital implications for fire investigations world-wide. It is a must-read for anyone involved in fire investigations and is available for download, free-of-charge, from the NIST-OSAC website.[3]

The *Strategic Vision Report* was written by the OSAC Fire and Explosion Investigations Subcommittee (SC). (More about OSAC is explained in section 3 of this article). The report authors are leaders in our field who are experts in various aspects of fire investigations: Craig Beyler, Ph.D., Philip Crombie, Jr., Chris Connealy, Mark Goodson, John Lentini, Melvin "Dixon" Robin, David Sheppard, Ph.D., Charles "Randy" Watson, and Chad Wissinger. The authors' credentials are summarized below.[4]

This article begins with a précis of the report published by the National Academy of Sciences and prepared by the National Research Council, *Strengthening Forensic Science in the United States: A Path Forward (the NRC Report*).[5] It was this groundbreaking report that called for an overhaul of the forensic sciences in the U.S. It also resulted in fire investigations becoming recognized as a forensic science discipline, which ultimately created the impetus for OSAC to respond to the *NRC Report through its Strategic Vision Repor*t.

Next, we review the roles of the National Institute of Standards and Technology (NIST) and OSAC in developing and promoting fire investigation standards. This is relevant since the *Strategic Vision Report* examines the importance of standards for the fire investigations field. The relationship between OSAC and the National Commission on Forensic Science (NCFS) is also briefly addressed, because the *Strategic Vision Report* has adopted several of the NCFS's recommendations. Thereafter we feature highlights from the report, consisting of excerpts of some of its most significant recommendations. We conclude with a few observations concerning the report's logical organization.

2. The Entry of Fire Investigations into the Forensic Sciences

The "big bang" event transporting fire investigations into the realm of forensic sciences occurred after the National Academy of Science published the *NRC Report*,[6] which was funded by Congress.[7] This 350-page exposé took a deep dive into the scientific reliability and validity of a number of forensic science disciplines and found many of them seriously wanting. Further, it noted that the problem caused by gaps in the scientific foundations of many disciplines is compounded by a number of factors putting pressures on the forensic science system, as well as by sources of error or even fraud by forensic practitioners.[8]

The *NRC Report* also examined the role of the judicial system in admitting forensic science evidence, concluding:

> The bottom line is simple: In a number of forensic science disciplines, forensic science professionals have yet to establish either the validity of their approach or the accuracy of their conclusions, **and the courts have been utterly ineffective in addressing this problem**. [Emphasis added.][9]

It was apparent to the *NRC Report's* authors that testimony based on either unreliable scientific premises or faulty analyses have been contributing factors in wrongful convictions.[10]

At first blush it appeared that the *NRC Report* was dealing with disciplines traditionally thought to constitute the forensic sciences such as laboratory sciences. However, upon closer examination, the report emphasized that it was addressing a "broad range of forensic science disciplines"[11] and included crime scene investigation as falling within its scope.[12] Though the authors did not address fire investigations in any depth, it specifically observed that, "much more research is needed on the natural variability of burn

patterns and damage characteristics and how they are affected by the presence of various accelerants."[13] After noting this deficiency in the scientific foundations of fire investigations, it raised the concern that some fire investigators were making determinations of incendiary fires based on burn patterns, "despite the paucity of research"[14] to support these determinations.

To address the shortcomings in the forensic sciences generally, the *NRC Report* made a number of recommendations. When it came time to implement these recommendations, it was necessary to determine which forensic science disciplines would be included in the overhaul. The two factors mentioned above were instrumental in causing fire investigations to become one of them. First, was the broad manner in which the report defined "forensic sciences" to include activities such as crime scene investigations. Second was the specific mention of the need for more research into the reliability of fire patterns as an indicator of arson.

In the next section, this article introduces NIST, OSAC and the NCFS, three of the organizations charged with implementing the *NRC Report*. In hindsight, the establishment of OSAC was a critical development for the betterment of the fire investigation discipline, leading directly to the publication of the *Strategic Vision Report*.

3. NIST, OSAC, the NCFS, and Their Roles in Fire Investigations as a Forensic Science Discipline

In the federal government, NIST is primarily responsible to oversee the development of forensic science standards.[15] NIST has taken several steps to implement the *NRC Report* recommendations, and one of those steps, in collaboration with the U.S. Department of Justice, was to create the NCFS and OSAC.[16]

The NCFS was a federal advisory commission established in 2013 and tasked with making policy recommendations to the U.S. Attorney General to improve the reliability of forensic sciences, particularly in the justice system. While the work of the NCFS was policy oriented, the second organization formed in 2014 under the leadership of NIST was OSAC. OSAC was charged with providing practice-based (as opposed to policy-based) scientific guidance to each forensic science discipline.

During its three-year term, the NCFS adopted many policy recommendations that were forwarded to the Attorney General for action. Several of these have since been adopted by the OSAC Fire and Explosion Investigation SC in its *Strategic Vision Report* as applicable to fire investigations.[17]

As for OSAC, its mission is to "strengthen the nation's use of forensic science by facilitating the development of scientifically sound standards, and by promoting the adoption of those standards."[18] One of the ways that OSAC fulfills its mission is by drafting or reviewing standards that are scientifically sound and placing them on the OSAC Registry:

> The OSAC Registry is a repository of high-quality, technically sound published and proposed standards for forensic science. These written documents define minimum requirements, best practices, standard protocols and other guidance to help ensure that the results of forensic analysis are valid, reliable and reproducible. All the standards on this registry have passed a rigorous technical and quality review by OSAC members, including forensic science practitioners, research scientists, statisticians and legal experts.[19]

OSAC encourages the forensic science community to implement standards on the registry. It also encourages members of the justice system in both civil and criminal cases to use Registry standards when evaluating the admissibility and weight of forensic experts whose work are governed by such standards.

Organizationally, OSAC's governing body is the Forensic Science Standards Board (FSSB). Seven Scientific Area Committees (SACs) and an Interdisciplinary Committee report to the FSSB. Each SAC is responsible to coordinate the work of subcommittees (SCs) representing each forensic discipline within a given area. For example, the Scene Examination SAC oversees three subcommittees including the Fire and Explosion Investigation SC. SCs bring together subject matter experts to review and draft standards that have sound technical merit.[20]

The term "standards" in this context refers to voluntary consensus standards (including guidelines) that are developed by "standards developing organizations" (SDOs). Each of these SDOs must meet requirements for openness, balance, consensus, and due process, and adhere to rules that provide an opportunity for all interested parties to participate in a standard's development.[21] In addition to reviewing and drafting standards, SCs also work with the SDO having the authority to create standards within a specified scope relating to their discipline.

The Fire and Explosion Investigation SC focuses on "identifying and improving standards, guidelines and best practices for conducting investigations and presenting results, identifying research needs, and proposing strategies for increasing the reliability of investigative determinations."[22] It works primarily with the National Fire Protection Association (NFPA), the SDO responsible for developing standards dealing with: a) the practice of conducting fire investigations; b) qualifications for fire investigators, and; c) requirements for fire investigation units. In other words, the Fire and Explosion Investigation SC assists OSAC to fulfill its mission through its work with the NFPA in developing standards

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for fire investigations and taking the lead in having them added to the Registry.[23]

4. *NRC Report* Recommendations and Highlights of the *Strategic Vision Report* Findings

The previous section of this article explained how the NCFS and OSAC were created as two of NIST's initiatives to implement the *NRC Report*. Many aspects of the *NRC Report* recommendations are directly addressed in the *Strategic Vision Report*, which specifically states that it is a response to the *NRC Report*.[24] Below are six components of the *NRC Report* recommendations, followed by related excerpts from the *Strategic Vision Report*. These excerpts highlight some of its more significant findings. You will see in these excerpts that the OSAC Fire and Explosion Investigation SC, through its Strategic Vision Report, is advocating that some of the NCFS's recommendations should be applied to the fire investigation discipline. Be aware that there are many more recommendations in the *Strategic Vision Report* than space permits us to cover here.

1) Reporting and Testifying: The NRC Report recommended that terminology and minimum requirements for information used "in reporting and testifying about the results of forensic science investigations be standardized;"[25]

Excerpts of the *Strategic Vision Report* on Fire Investigation Reports:

> [I]nvestigators need to be able to articulate the scientific method and demonstrate how it was applied to the investigation. Hypothesis development and testing need to be effectively communicated. Rigorous independent review of the investigation is needed to assure quality work product.[26]
>
> All stakeholders need to take responsibility for requiring complete and comprehensive fire and explosion investigation reports.[27]
>
> **Recommendation:** *Fire and explosion investigation reports should include all data collected, all hypotheses formulated, details of the testing process for each hypothesis, and the conclusions of the investigation.*
>
> **Recommendation:** *In a case where an incendiary fire cause has been alleged, the origin and cause of the fire should be thoroughly explored through discovery or evidentiary hearings*
>
> …
>
> **Recommendation:** *All stakeholders (investigators, managers, lawyers, judges, insurance companies) must take responsibility for requiring complete and comprehensive fire and explosion investigation reports.*[28]

Excerpts of the Strategic Vision Report on expressing certainty in reports and testimony:

> On March 22, 2016, the NCFS voted to recommend that the term "reasonable certainty," whether couched as "scientific certainty" or "[discipline] certainty", **should not be used**. [Emphasis in the original][29] …
>
> The OSAC Subcommittee on Fire and Explosion Investigations urges fire investigators to follow the NCFS Recommendations and avoid the use of the term "reasonable degree of scientific [or discipline] certainty" unless the Court insists.

2) Human Error and Bias: The *NRC Report* recommended that research be conducted on human error rates and bias in forensic examinations;[30]

Excerpts of the *Strategic Vision Report* on Human Error and Mitigating Bias:

> Investigative errors can arise in data collection, data analysis, development, and testing of hypotheses. Failure to collect sufficient data and misinterpretation of data can cause erroneous findings. Further, the use of biasing irrelevant data can lead to investigative errors. Expectation bias arises when premature conclusions are reached. Confirmation bias arises when investigators lapse into attempts to prove rather than disprove a hypothesis.[31]
>
> Fire and explosion investigation units need to implement information management practices to minimize bias and reduce exposure to task-irrelevant data. Also, there is a need for fire investigation units to fully implement the scientific method and technical review processes to minimize potential bias.[32]
>
> To guard against presumptions and mitigate bias, there is a need to consider only data that are relevant to the current task (see NCFS [2016] concerning the need to limit data considered to that which is relevant to the current task).[33] If the task is the determination of origin and cause of the fire, then relevant data includes information about the fire scene and the actions that occurred at the fire scene. The data may relate to the fire scene and actions before the fire, during the fire, and after the fire. The data may be physical or may be an action or observation. The relevance relates to the value of the data in determining where the

fire originated, how it was caused, or how the fire developed.[34]

Task-irrelevant data, as it pertains to origin and cause determination, often relate to motives. Financial, criminal history, social relationship stress, evasive, or deceptive behavior information are not relevant to the determination of the origin or cause of a fire.[35]

Recommendation: *Fire and explosion investigation units should implement practices to minimize potential bias by using such processes as rigorous adherence to the scientific method, a technical review process, and processes to limit the exposure of investigators to biasing information.*[36]

3) Mandatory Accreditation and Certification: The *NRC Report* recommended that "[l]aboratory accreditation and individual certification of forensic science practitioners should be mandatory;"[37]

Excerpts of the *Strategic Vision Report* on Universal Certification of Fire Investigators:

The OSAC Fire and Explosion Investigation Subcommittee agrees with the National Commission on Forensic Science's position that fire investigators, as forensic science practitioners, should become certified [NCFS 2016].[38] Any valid certification program requires the fire investigator to be re-certified periodically by maintaining a minimum number of continuing education hours. … **Recommendation:** *Certify fire investigators by a third party and obtain other credentials that ultimately enhance their knowledge. [Emphasis in the original]*[39]

In addition, fire investigators need competency as well as proficiency testing. Competency testing demonstrates the successful completion of a tested training course, while proficiency testing is where the fire investigator's performance is evaluated through their reports, trial/deposition performance, mock reliability hearings, and reviews of investigations by independent third parties. Though not a regular function within most fire investigation units, proficiency evaluation needs to be as common as competency testing.[40]

Excerpts of the *Strategic Vision Report* on Universal Accreditation of Fire Investigation Units:

The National Commission on Forensic Science (NCFS) has called for the accreditation of all forensic science service providers [NCFS 2017].[41] They identify both the benefits and challenges in this process.[42]

OSAC was established to review existing forensic science standards to identify or create best practices or new standards that forensic science practitioners need to adhere to in their daily operations to facilitate a better criminal justice system that relies on solid science. The standards and best practices approved by OSAC can then be incorporated into an accrediting program with performance measures that fire investigation organizations should follow to become accredited.[43]

The field of fire and explosion investigation needs to move toward accreditation of all fire and explosion investigation units. In 2016, the OSAC Fire and Explosion Investigation Subcommittee proposed that NFPA develop a Standard on the Organization and Operation of Fire Investigation Units. That proposal was accepted, a technical committee was formed, and a proposed draft of the standard was submitted to NFPA (NFPA 1321). This standard should provide a foundation for accreditation of fire and explosion investigation units.[44]

Recommendation: *Require accreditation of fire investigation units by third parties based on an applicable consensus standard.*[45]

4) Code of Ethics: The *NRC Report* recommended that "[c]ertification requirements should include, at a minimum, written examinations, supervised practice, proficiency testing, continuing education, recertification procedures, adherence to a code of ethics, and effective disciplinary procedures."[46]

Excerpts of the *Strategic Vision Report* on Implementing a Code of Ethics:

The implementation of a Code of Ethics requires a written procedure for handling complaints or misconduct. Such a procedure should be detailed, and provide the complainant, the respondent, and the body reviewing the complaint with a clear set of instructions on how to proceed. This includes notification of the respondent, investigating the complaint procedures for protecting confidentiality, and potential sanctions. Different players in the criminal justice system have different ethical obligations. These distinctions should be spelled out in the Code of Ethics.[47] **Recommendation:** *Require fire investigation units to adopt a Code of Ethics.*[48]

5) Foundational Research: The *NRC Report* recommended that research be conducted to verify the "accuracy, reliability, and validity" of the basic premises underlying each discipline;49

Chapter 7 of the Strategic Vision Report is dedicated to identifying research needs for the fire investigation discipline. The recommendations are too lengthy to reproduce in this article. To summarize,

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there are 10 research agenda items identified for origin determination (including fire patterns, arc mapping, witness information and electronic data, and fire dynamics), one for cause determination, and five for getting research into practice. Many of these research recommendations point to gaps in the scientific foundations of fire investigations. As such, investigators and others involved with fire investigations should consider the extent to which they point to sources of uncertainties or limitations in formulating opinions.

6) Industry Standards: The *NRC Report* recommended that practitioners comply with industry standards that reflect the best practices in their fields.[50]

Excerpts of the *Strategic Vision Report* re: Complying with Industry Standards:

These consensus documents [NFPA 921, NFPA 1033 and NFPA 1321] fulfill the basic elements of the quality triangle in forensic science, with NFPA 921 providing the standardization of procedures and practices, NFPA 1033 providing the basis for qualifications and certification of investigators, and the new NFPA standard (NFPA 1321) providing the basis for accreditation of investigation units.[51]

Fire investigators must consistently prove that they adhere to the current science in the profession, and the criminal justice system needs to require all participants in the fire investigation to comply with national best practices.[52]

OSAC was established to review existing forensic science standards to identify or create best practices or new standards that forensic science practitioners need to adhere to in their daily operations to facilitate a better criminal justice system that relies on solid science. The standards and best practices approved by OSAC can then be incorporated into an accrediting program with performance measures that fire investigation organizations should follow to become accredited.[53]

When considering the S*trategic Vision Report's* position concerning compliance with best practices embodied in industry standards, it is noteworthy that the report repeatedly references NFPA 921 *Guide for Fire and Explosion Investigations* and NFPA 1033 *Standard for Professional Qualifications for Fire Investigator.* These are the two industry standards that have been approved by the OSAC Fire and Explosion Investigation SC and added to the OSAC Registry.

5. Conclusion: Digesting the Report

Thankfully, the authors of the *Strategic Vision Report* were cognizant of the need to present the contents so that it would be user-friendly for its readers. The report is very well organized. In addition to an abstract, it begins with an Executive Summary that provides a chapter-by-chapter overview of the report contents. Next, all of the recommendations that are intertwined throughout the report are collected in a separate "Recommendations" section. The various affected "stakeholders" who need to take action to implement each recommendation are also listed. There are nine chapters, set forth in a logical order, which are conveniently divided into subsections to make the material easier to absorb and navigate. Finally, the Fire and Explosion Investigation SC has developed a presentation discussing the key provisions of the *Strategic Vision Report* that is available to interested groups.

In closing, the members of the OSAC Fire and Explosion Investigation SC should be proud of this *Strategic Vision Report*. Not only does it describe a path ahead for the fire investigation discipline, but it also shares a vision for the future roles of fire investigation's leading organizations such as the IAAI and NAFI. It is relevant to all members of the fire investigation community and should be studied with the same vigor as the discipline's leading authoritative references such as NFPA 921 and NFPA 1033.

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ENDNOTES

1 **Disclaimer:** To the extent that this article contains opinions, they are the opinions of the authors and not of the International Ass'n of Arson Investigators (IAAI), the IAAI Fire Investigation Standards Committee (FISC), or the National Fire Protection Association.

2 ORG. OF SCI. AREA COMM. FOR FORENSIC SCI., FIRE & EXPLOSION INVESTIGATION SUBCOMM., OSAC *Technical Guidance Document 0005—Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward* (2021), https://doi.org/10.29325/OSAC.TG.0005 (last visited Sept. 14, 2021).

3 NIST, OSAC Webpage, *Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward*, available at https://www.nist.gov/osac/strengthening-fire-and-explosion-investigation-united-states-strategic-vision-moving-forward (last visited Sept. 15, 2021).

4 The following were members of the OSAC Fire and Explosion Investigation Subcommittee at the time the *Strategic Vision Report* was written:

Craig Beyler, Ph.D., Technical Director Emeritus, Jensen Hughes, who was the first Chair of the OSAC Fire and Explosion Investigations Subcommittee, promoted in 2020 to Chair of the Scene Examination Scientific Area Committee (SAC) and member of the Forensic Science Standards Board, and a former member of the NFPA 921 Committee on Fire Investigations (NFPA 921 Committee);

Philip Crombie, Jr., 2nd Vice President, Travelers Forensic Laboratory, a fire protection engineer who is also a member of the NFPA 921 Committee and now serves as Chair of the OSAC Fire and Explosion Investigations Subcommittee;

Charles "Randy" Watson, IAAI-CFI®, IAAI-CI, CFEI, CVFI, SEA, Ltd., 1st Vice President IAAI, former chair of the NFPA 921 Committee, current Chair of the NFPA 1321 Committee on Fire Investigation Units (NFPA 1321 Committee), and member of the NFPA 1033 Committee on Fire Investigator Professional Qualifications (NFPA 1033 Committee);

John Lentini, CFI, D-ABC, President, Scientific Fire Analysis LL.C., member of the NFPA 1033 Committee, member and former Chair of the ASTM Committee E30 on Forensic Sciences, and former member of the NFPA 921 Committee;

Chris Connealy, Senior Director - Emergency Services at Williamson County, TX, former Texas State Fire Marshal, member of the NFPA 1321 Committee, and former member of the NFPA 921 Committee;

Mark Goodson, PE, Principal Engineer at Goodson Engineering, member of the NFPA 1321 Committee, member of the NFPA 1033 Committee;

Melvin "Dixon" Robin, CFI, Special Agent, Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) (Retired), Fire Sequence Investigations, LLC.— Founder and Principal Investigator;

David Sheppard, Ph.D., Senior Technical Advisor at the ATF;

Chad Wissinger, Forensic Laboratory Chief, Ohio Division of State Fire Marshal Forensic Laboratory, member of the NFPA 921 Committee, and member of the NFPA 1321 Committee.

5 COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCI. CMTY. ET AL., NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD (2009), *available* at https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf [hereinafter NRC Report].

6 *Id.*

7 NRC Report, *supra*. note 5, at 1, "On November 22, 2005, the Science, State, Justice, Commerce, and Related Agencies Appropriations Act of 2006 became law. [*Citing* P.L. No. 109-108, 119 Stat. 2290 (2005).] Under the terms of the statute, Congress authorized "the National Academy of Sciences to conduct a study on forensic science … . [*Citing* H.R. Rep. No. 109-272, at 121 (2005) (Conf. Rep.).]"

8 NRC REPORT, *supra* note 5, at 35-38, 39-40, 44-48.

9 NRC REPORT,*supra* note 5, at 53.

10 NRC REPORT, *supra* note 5, at 4.

11 NRC REPORT, *supra* note 5, at 6.

12 NRC REPORT, *supra* note 5, at 38.

13 NRC REPORT, *supra* note 5, at 172-3.

14 NRC REPORT, *supra* note 5, at 172-3.

15 Org. of Sci. Area Comm. for Forensic Sci., Forensic Sci. Standards Board, *OSAC Charter and Bylaws, Version 1.8* (2021), https://www.nist.gov/osac/governing-documents (last visited Sept. 14, 2021), sec. 1.

16 OSAC was originally created under NIST's leadership pursuant to a Memo of Understanding between NIST and the U.S. Department of Justice. *See* Memorandum of Understanding Between the Department of Justice and The National Institute of Standards and Technology in Support of The National Commission on Forensic Science and The Organization of Scientific Area Committees, August 2015, para. II. According to OSAC's Charter and Bylaws, NIST is solely responsible for OSAC's administration. *See* Org. of Sci. Area Comm. for Forensic Sci., Forensic Sci. Standards Board, *OSAC Charter and Bylaws, Version 1.8* (2021), https://www.nist.gov/osac/governing-documents (last visited Sept. 14, 2021), sec. 2.

17 All of the NCFS work products, including the ones referenced in the *Strategic Vision Report*, are available on the U.S. DOJ's website: https://www.justice.gov/archives/ncfs (last visited Sept. 15, 2021).

18 OSAC's Charter and Bylaws, *supra*. note 15 at sec. 1.1.

19 NIST, OSAC Registry Webpage, available at https://www.nist.gov/osac/osac-registry (last visited Sept. 15, 2021).

20 Org. of Sci. Area Comm. for Forensic Sci., Forensic Sci. Standards Board, *Terms of Reference for the Subcommittees Version 2.3* (2021), https://www.nist.gov/osac/governing-documents (last visited Sept. 14, 2021).

21 The SDOs that develop OSAC Registry standards are accredited by the American National Standards Institute (ANSI), which reviews the procedures of the SDOs and approves those documents that are developed under these procedures as American National Standards. *See About ANSI-ANSI's Roles*, THE AMERICAN NATIONAL STANDARDS INSTITUTE, https://www.ansi.org/about/roles.

22 ORG. OF SCI. AREA COMM. FOR FORENSIC SCI., FIRE & EXPLOSION INVESTIGATION SUBCOMM., *OSAC Technical Guidance Document 0005—Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward* (2021), https://doi.org/10.29325/OSAC.TG.0005 (last visited Sept. 14, 2021), at 1, fn 8.

23 The way in which the SCs work with SDOs for the development of standards with the ultimate goal of placing them on the Registry is a complex process that is explained in detail on the OSAC website. *See* NIST, OSAC Website, available at https://www.nist.gov/osac (last visited Sept. 15, 2021).

24 *Strategic Vision Report*, *supra* note 22 at 1.

25 NRC REPORT, *supra* note 5, at 21-22.

26 *Strategic Vision Report*, *supra* note 22 at xvii.

27 *Strategic Vision Report*, *supra* note 22 at iv.

28 *Strategic Vision Report*, *supra* note 22 at 99.

29 *Strategic Vision Report*, *supra* note 22 at 33, citing NCFS, Recommendations to the Attorney General Regarding Use of the Term "Reasonable Scientific Certainty" March 3, 2016. https://www.justice.gov/ncfs/file/839726/download

30 NRC REPORT, *supra* note 5, at 24.

31 *Strategic Vision Report*, *supra* note 22 at xvii.

32 *Strategic Vision Report*, *supra* note 22 at iv.

33 *Strategic Vision Report*, *supra* note 22 at 92, citing National Commission on Forensic Science (2016), Work Products of the FCFS, https://www.justice.gov/archives/ncfs/work-products-adopted-commission

34 *Strategic Vision Report*, *supra* note 22 at 92.

35 *Strategic Vision Report*, *supra* note 22 at 92-93.

36 NRC REPORT, *supra* note 5, at 95.

37 NRC REPORT, *supra* note 5, at 25.

38 *Strategic Vision Report*, *supra* note 22 at 117, citing National Commission on Forensic Science-Views of the Commission, Certification of Forensic Science Practitioners (September 12, 2016). https://www.justice.gov/archives/ncfs/page/file/905897/download

39 ORG. OF SCI. AREA COMM. FOR FORENSIC SCI., FIRE & EXPLOSION INVESTIGATION SUBCOMM., *OSAC Technical Guidance Document 0005—Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward* (2021), https://doi.org/10.29325/OSAC.TG.0005 (last visited Sept. 14, 2021), at 117.

40 Strategic Vision Report, *supra* note 39 at xx-xxi.

41 Strategic Vision Report, *supra* note 39 at 120, citing National Commission on Forensic Science (2017), Work Products of the NCFS, https://www.justice.gov/archives/ncfs/work-products-adopted-commission

42 *Strategic Vision Report*, *supra* note 39 at 120.

43 *Strategic Vision Report*, *supra* note 39 at 120.

44 *Strategic Vision Report*, *supra* note 39 at iv.

45 *Strategic Vision Report*, *supra* note 39 at 123.

46 NRC REPORT, *supra* note 5, at 25.

47 NRC REPORT, *supra* note 5, at 130.

48 NRC REPORT, *supra* note 5, at 130.

49 NRC REPORT, *supra* note 5, at 22.

50 NRC REPORT, *supra* note 5, at 23-25.

51 *Strategic Vision Report*, *supra* note 39 at xii.

52 *Strategic Vision Report*, *supra* note 39 at 117.

53 *Strategic Vision Report*, *supra* note 39 at 120.