

Problematic Aspects of Appointing and Conducting a Forensic Fire Investigation

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The authors aimed to outline problematic aspects of individual stages in investigation of circumstances of the fire; to formulate recommendations regarding requirements for the inspection of the scene and the circle of expert witnesses who should participate in this inspection, regarding the specifics of the appointment of forensic fire investigations and further evaluation of results of the conducted research; pay attention to errors that a forensic expert may make during a forensic fire investigation and reasons for such errors. For achieving this goal, general scientific and special scientific methods are applied, in particular, analysis, synthesis, analogy; formal and logical; logical and legal; systemic and structural ones. It has been proven that methods and expert techniques determined by the investigative-expert situation at each stage of the investigation should be used to investigate the fire. In order to prevent erroneous expert conclusion, the need to update to modern level of development of science and technology and unify methodical recommendations and forensic methods for conducting forensic researches on all possible objects at each of the stages of fire investigation has been identified. It is emphasized that the following criteria should be used to evaluate

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the results of a forensic fire research and form forensic expert conclusion: availability of dangerous process signs; the existence of fire-hazardous process factors; coincidence of detection place of fire-hazardous factor with the fire center; possibility of combustion from such a fire-hazardous factor; justified exclusion of other possible factors of fire occurrence. Errors that are most often assumed while conducting of forensic a fire investigations and preparation of forensic expert conclusion are highlighted.

Keywords: forensic expert, forensic fire investigation, fire scene inspection; forensic research; assessment of forensic expert's conclusion; forensic examination objects.

Research Problem Formulation

Recently, a significant number of fires not related to military actions on the territory of our country have been recorded in Ukraine, investigation and identification of the culprits in their occurrence is an urgent task of law enforcement agencies. Extensive and developed system of the domestic fire service and the state of the theoretical and methodical foundations of forensic fire investigations testify to existing potential for significantly expanding the possibilities of specific expertise applying in the investigation of events related to fires.

Note that it is often quite difficult to determine fire causes, as they are determined by occurrence and course of fire specifics. For this purpose, it is necessary to examine a specific event in retrospect as an independent issue, necessarily taking into account possibility of the use of various types of tricks by criminal subjects, for example, with the aim of disguising arson as spontaneous combustion or a fire caused by careless fire handling.

Scientists noted a wrong practice, when some criminal events related to fires were not even assigned forensic fire investigations: expert studies were replaced by official memos or conclusions provided by official fire inspectors, which ultimately led to the closure of criminal proceedings. We consider it a valid opinion that the conclusions of commissions, acts of departmental investigations, acts of technical condition and other similar documents cannot replace the opinion of an expert in the field of forensic fire investigation ¹: such documents do not have independent procedural significance, since the research recorded in them was carried out outside procedural boundaries, and the persons involved in the conducting this research have neither procedural rights nor procedural obligations.

In addition, there is a lack of uniform guidelines for Ukrainian professionals on conducting forensic researches on all possible objects during fire investigation. At the same time, current national and foreign guidelines on forensic fire

1 Тилеубергенов Е. М. Теоретические и практические проблемы применения данных естественных и технических наук в процессе раскрытия и расследования преступлений : дис. ... д-ра юрид. наук. Бишкек, 2019. С. 180.

investigation ² need to be revised and updated in accordance with the modern level of development of science and technology. For its part, systematization of objects in proceedings about a fire event will contribute, in particular, to development by scientists of uniform forensic guidelines and methods for expert research of such objects; will prevent the application of methodological recommendations that do not meet the requirements of current procedural legislation, or forensic methods which use can cause erroneous conclusions of experts (for example, if these methods are not intended for conducting forensic fire investigations, but for investigating other fire aspects).

The above-mentioned issues make necessary to outline the main steps of investigating authorities in investigation of fire circumstances: from the scene inspection to the assessment of the expert's conclusion.

Analysis of Essential Researches and Publications

Expediency of forensic research on crime scene was insisted, in particular, by such forensic scientists as S. P. Mytrychev ³ and N. O. Selivanov ⁴. We agree with them, since

expediency of forensic fire researches during the fire investigation is determined by:

- the need to determine place and location of objects relative to each other in the territory where the fire occurred;
- mechanism specifics of formation and condition of trace objects, as well as trace-sensing surfaces (such surfaces may have a fragile structure, occupy large areas, etc., that complicates, reduces efficiency, and sometimes even makes it impossible to transport and provide such objects for forensic research);
- specifics of topographic place relief of particular fire, atypical layout of premises, placement of equipment, etc.

Analysis of scientific best practices indicates that scene inspection, like any other investigative action, requires diligent preparation and management. As V. I. Honcharenko, correct management of investigative action makes it possible to conduct its thorough preparation, invite necessary persons to participate, provide for use of scientific and technical means, provide security (if necessary), etc ⁵. V. M. Kitseliuk formulated the

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- 2 Коротких Н. И., Мартынюк В. И. Методическое пособие по вопросам установления причин возникновения пожаров и подготовки материалов для проведения пожарно-технической экспертизы. Черновцы, 1982. 199 с. ; Нам А. Г. Установление признаков горения древесины пола с различными покрытиями в присутствии легковоспламеняющихся жидкостей (ЛВЖ) или горючей жидкости (ГЖ) нефтяной природы. *Экспертная практика* : сб. метод. рек. 1993. Вып. 1. 10 с. ; Его же. Методические подходы к проведению интеграционных экспертных исследований по установлению элементов механизма пожара. *Теоретические и практические вопросы судебной экспертизы* : сб. науч. тр. ЦСЭ Минюста Респ. Казахстан, 2002. Вып. 5. С. 181–184.
 - 3 Митричев С. П. Значение пожарно-технической экспертизы при расследовании пожаров. *Ташкентская криминалистическая конференция* : сб. мат-лов науч. конф. Ташкент, 1986. С. 32–33.
 - 4 Селиванов Н. А. Некоторые вопросы теории и практики комплексной экспертизы. *Вопросы судебной экспертизы* : тез. докл. науч. конф. Тбилиси, 1962. С. 18–20.
 - 5 Гончаренко В. И. Научно-технические средства в следственной практике. Київ, 1984. С 42.

tasks, organizational aspects, tactics and methods of conducting scene inspection during the investigation of violations of fire safety requirements, as well as the specifics of this investigative action ⁶.

Monograph of M. L. Tsymbal analyzes the main provisions of tactics of scene inspection and certain issues of specific expertise application during investigation of fires. The scientist notes that if investigator, who is the head of the group, does not have specific expertise, then he should take measures to instruct the participants in this group about safety rules during the disassembly of structures and fire debris. He emphasizes that purpose of application of tactical methods of inspection of fire site is to identify the characteristic traces of combustion zone, heat exposure and smoke, determine the boundaries and forms of fire development, to search for signs of the occurrence center its and ways of spread, to detect traces and other material evidence ⁷.

O. B. Shmereho notes that the initiators of forensic fire and technical examinations are most often interested in the location of the fire and the causes of its occurrence. However, in recent years, questions of compliance with fire safety requirements have been increasingly raised for the said examination;

effectiveness of the actions of fire departments during extinguishing fires in procedure of fire and rescue operations, etc. The researcher focuses on the need to correctly formulate the issues that need to be resolved by the person who appoints forensic fire investigation ⁸. For correct formulation of questions, investigator should consult with a specialist in the relevant field of knowledge.

A. V. Lisitskyi's dissertation examined conceptual principles of applying specific expertise during investigation of criminal offenses committed by arson, formulated theoretical provisions and gave practical recommendations. The scientist calls inspection (in particular, inspection of the scene), interrogation, search, involving an expert and carrying out forensic examination as typical investigative (search) actions in such situations. The researcher analyzes general principles and specifics of conducting typical types of forensic examinations during investigation of criminal offenses committed by arson, distinguishing among the group of forensic fire investigations, life safety, electrical, engineering and transport, etc. ⁹. Unfortunately, A. V. Lisitskyi neglected other possible areas of forensic fire investigations and their specifics.

Interesting developments on the subject can be found on website of the

6 Кіцелюк В. М. Особливості проведення огляду місця події під час розслідування порушень вимог пожежної безпеки. *Прикарпатський юридичний вісник*. 2015. Вип. 3 (9). Т. 2. С. 226—230. URL: http://pjv.nuova.od.ua/v3-2_2015/51.pdf (date accessed: 25.04.2023).

7 Цимбал М. Л. Розслідування пожеж (огляд місця події та проблеми застосування спеціальних знань) : монографія / за ред. д-ра юрид. наук, проф. В. Ю. Шепітька. Харків, 2004. С. 51, 97.

8 Шмерего О. Б. Використання спеціальних знань при проведенні пожежно-технічних експертиз та експертних досліджень. *Криміналістика і судова експертиза*. 2020. Вип. 65. С. 432—441. DOI: 10.33994/kndise.2020.65.42 (date accessed: 25.04.2023).

9 Лісіцький А. В. Використання спеціальних знань під час розслідування кримінальних правопорушень, вчинених шляхом підпалу : дис. ... д-ра філос. за спец. 081 — Право. Київ, 2023. 298 с.

*Efectis*¹⁰ groups and the applied researches on fires and the environment of the *Pacific Wildland Fire Sciences Laboratory*¹¹.

Scientists noted insufficiency and issues of theoretical and practical provision of forensic fire researches, among which determination of forensic expert competence in the field of forensic fire investigations has a special place; systematization of forensic examination objects in this direction; determination of typical tasks and types of expert studies on fire investigation¹². We are forced to note that mentioned developments are not specified on individual issues: they have limited recommendations for the appointment initiators of forensic Effects fire investigations, therefore they require additional coverage.

Article Purpose

Outline problematic aspects of individual stages in fire investigation circumstances; formulate recommendations regarding requirements for incident scene inspection of the and the circle of expert witnesses who should participate in this inspection, regarding appointment specifics of forensic Effects fire investigations and further evaluation of conducted research results; pay attention to errors that a forensic expert can make during forensic fire investigation, and the reasons for such errors.

Research methods

For achieving the goal, general scientific and special scientific methods are applied, in particular, analysis, synthesis, analogy; formal and logical; logical and legal; systemic and structural ones.

Main Content Presentation

It is worth noting that almost always fires occur in conditions of non-obviousness, in addition, fire destroys a lot of material evidence, which study could speed up investigation procedure and clarification of circumstances associated with occurrence and development of combustion. Taking into account the tasks and specifics of the objects provided to forensic expert for research on the fire fact and in order to find out the fire causes, the following issues are subject to resolution:

- fire-technical profile (regarding fire extinguishing equipment and tactics, fire prevention, etc.);
- natural-scientific (most often physical and chemical) direction;
- technical (mostly heat and electrical) nature;
- fire causes (usually at the request of the investigator or the court).

Such circumstances increase importance of specific expertise applying in the natural and technical sciences, which in a difficult situation of outlined direction make possible to:

10 Fire Safety Experts. URL: https://effectis.com/app/uploads/2023/05/Efectis_Group_Brochure_May_2023_Italian_version.pdf (date accessed: 25.04.2023) ; Fire Testing For Railway And Marine Sectors. URL: https://effectis.com/app/uploads/2023/03/Efectis_Fire_testing_for_railway_and_marine_sectors_March_2023.pdf (date accessed: 25.04.2023) ; Fire Investigations. URL: <https://effectis.com/app/uploads/2022/01/Fire-Investigation-June2022.pdf> (date accessed: 25.04.2023).

11 Fire and Environmental Research Applications Team / US Forest Service. URL: <https://www.fs.usda.gov/pnw/fera/research/index.shtml> (date accessed: 25.04.2023).

12 Тилеубергенов Е. М. Указ. соч.

- diagnose causes, sequence of occurrence and mechanism of fire development;
- detect cause-effect relations with the event under research, offense mechanism and the behavior of people or natural phenomena that caused the occurrence, spread and fire consequences;
- investigate fire hazard of material objects, assess their compliance with regulatory and technical requirements for fire safety.

In addition, application of specific methods and forensic methods for investigating the traces of fires depends on the tasks to be solved and the investigated objects. Regardless of fire cause, it is necessary to conduct a full investigation into the incident and determine whether it is a criminal offense. For a competent answer to raised questions, it is advisable to study not only physical evidence, but the situation at the scene; find out the cause-effect relations between research objects and the traces found on various objects from the scene. Careful study of the scene situation is especially important if it is not possible to move objects that are material evidence (with possible traces of criminal actions of the participant of the event and/or the criminal) from this place to the expert laboratory due to various reasons: bulkiness, a high degree of possible damage, distortion threat in case of movement, etc.¹³.

The above has a conceptual significance, since during the forensic fire and technical examinations it is necessary to identify traces of temperature influence, which affects different objects differently, fix them and find out cause-

effect relations between these traces and the objects selected during investigative actions. Accordingly, at the fire location, it is possible to detect both trace-forming and trace-sensing objects, the examination of which by forensic expert will help determine the ignition mechanism and spread of fire.

Scientists note that effective inspection of the fire site sometimes requires knowledge that investigator cannot have. Therefore, the circle of participants in such a review is extremely important for management of initial and further actions in the scene inspection. At the discretion of the investigator, depending on specific circumstances, specialists from other fields of knowledge can be involved in inspection, for example:

- electrician to assist in inspection of electrical equipment, electrical grids;
- land-surveyor for filming a large object;
- builder to determine structural defects of the premises in connection with occurrence and spread of fire;
- biologist, chemist, materials scientist, ecologist, etc., persons who have specific expertise in other fields¹⁴.

V. D. Bezvesilnyi and O. F. Diachenko suggest dividing the process of organizing a fire site inspection into three main stages:

- 1) *stage of familiarization with situation at the scene* (which allows to find out the circumstances that took place before the fire; determine inspection tactics and measures for its implementation; bypass the fire in a certain sequence;

¹³ Тилеубергенов Е. М. Указ. соч. С. 186.

¹⁴ Кіцелюк В. М. Зазнач. твір. С. 229–230. URL: http://piv.nuoua.od.ua/v3-2_2015/51.pdf (date accessed: 25.04.2023).

- establish the most important areas and elements to be inspected);
- 2) *stage of direct inspection of the scene* (related to the definition of the fire, the characteristics of the fire load and the ignition source; establishment of the directions of fire spread; comparison of what was seen with the patterns of occurrence and spread of fire; identification of negative probable circumstances at the scene);
 - 3) *final stage of scene inspection* (aimed at seizing material evidence; recording results of the scene inspection, etc.)¹⁵.

At the same time, in forensic sources, it is common to distinguish inspection stages of the fire location: general and detailed. Thus, at the *general inspection* stage, everything seen and located at the scene in the post-fire state is recorded; its purpose is a general acquaintance with the scene, assessment of the situation after the fire and the definition of further action tactics. A *detailed inspection* involves examining the areas of fire development according to consequences of their impact on structural materials, individual objects, bodies of people and animals¹⁶.

Therefore, the objects of forensic fire investigation are both separately discovered and removed objects from the scene, as well as the entire situation of the scene without exception. Therefore, forensic expert in forensic fire investigation usually begins with a forensic scene inspection, that (unlike an investigative inspection) is not a component of a procedural action, but a separate element of forensic examination,

reflected in the expert's conclusion. It should be recognized that the expert's personal perception of situation at the fire scene after studying its individual details increases the effectiveness and reliability of conducted forensic research and the conclusions drawn on this basis.

Depending on the time of forensic fire investigation, it is possible to conduct forensic expert inspection after an investigative examination with a preliminary reproduction of the situation at fire location in accordance with the protocol or without its reproduction. Forensic inspection is carried out if forensic expert during examination in laboratory on the seized material evidence needs to investigate the situation of the fire scene in general. After such an inspection, it can be necessary to conduct forensic researches directly at the fire location.

If there is a need to conduct forensic researches at the scene, the investigator conducting investigation should create necessary conditions for forensic expert to conduct such an examination, which is expressly provided for in Article 6 "Ensuring the working conditions of a forensic expert at the location of the objects of research" of the Law of Ukraine: *On Judicial Examination: "If a forensic examination should be conducted at the scene or at the location of research object, the person or body who appointed it or commissioned it should provide forensic expert with unhindered access to the object of research and proper working conditions"*¹⁷.

It is well known that forensic expert conclusions should be based on the

15 Безвесільний В. Д., Дьяченко О. Ф. Розслідування та судові експертизи пожеж : довід.-метод. посіб. Харків, 2007. 360 с.

16 Ibid. С. 6.

17 Про судову експертизу : Закон України від 25.02.1994 р. № 4038-XII (зі змін. та допов.). URL: <https://zakon.rada.gov.ua/laws/show/4038-12> (date accessed: 25.04.2023).

results of a comprehensive analysis of the field of science or technology where this expert works, and always have a scientific character. Expert studies on the restoration of individual episodes of fire mechanism are designed to perform one of the main tasks of interdisciplinary study of direct subject of expert research, that as a result of individual researches, aims to solve the issues of different cognitive levels.

Taking into account complexity and versatility of multidisciplinary examinations, such methods as modeling and expert reconstruction should become the leading methods in the expert activities to determine the fire mechanism. We consider the opinion of Luzghin about special importance of modeling method when performing expert research to find out crime mechanism: he emphasizes that during the modeling there is a creation of a new analogue object based on information about the original, and during reconstruction there is an imaginary or objective reproduction of the situation using fragments of the original¹⁸.

Research papers of H. L. Hranovskyi in the 1960s also contain a scientific and theoretical justification for use of modeling and situational analysis methods in expert research to solve issues related to the location of a specific event¹⁹. We consider it expedient to state that situational analysis is an activity of a comprehensive study of things and changes in environment in a complex and cumulative manner. In the process of situational analysis, expert mentally

forms a module of intermediate stages of the criminal event that happened, could happen or could not happen at all. Situational analysis is characterized by the interweaving of the methods of induction and deduction when the method of deductive analysis leads to the acquisition of a whole series of separate conclusions, and the method of induction is aimed at the study of the entire complex of existing elements and their general structure as a single whole.

It should be noted that situational analysis (along with retrospective research of connections between situational episodes) makes possible to predict event development. For example, situational analysis of combustion peculiarities and related phenomena at the stages of fire development makes possible to assess reliability of the conclusion made at the first research stage, and together with it helps to find a logical connection between occurrence of a fire and its consequences. Effectiveness of this analysis is the higher, the earlier the fire is detected and the more qualitatively the material situation is recorded.

Taking into account that during the expert's research aimed at clarifying the mechanism of investigated fire, volume and content of information are constantly changing, the models used by forensic expert to adequately reflect the stages of expert knowledge should change. Scientists are convinced that above investigation procedure in general can be represented by alternation of constantly

18 Лузгин И. М. Реконструкция в криминалистических экспертизах. *Современные проблемы судебной экспертизы и пути повышения эффективности деятельности судебно-экспертных учреждений в борьбе с преступностью* : тез. докл. Респ. научн. конф. Киев и Харьков. НИ-ИСЭ. Киев, 1983. С. 47—49.

19 Грановский Г. Л. О моделировании и математических методах исследования в криминалистической экспертизе. *Проблемы социалистической законности на современном этапе развития советского государства* : тез. докл. межвуз. науч. конф. (Харьков, 25.10.1968). Харьков, 1968. С. 258—260.

changing models, which specifics are due to both the category of the case and conditions of the investigation ²⁰. Consequently, application of a certain research model to analyze the mechanism of investigated fire depends on the specific investigative and forensic situation that arises at a particular stage of investigation, and on information peculiarities provided to forensic expert.

It should be noted that improving efficiency and quality of multidisciplinary forensic research on fires requires further development of methodological aspects of integration forensic research (for example, certain methods of integration research: situational analysis, modeling, expert reconstruction). At the same time, it is necessary to improve procedural regulation, since the current legal framework does not fully meet the specifics of the current state of the Institute of forensic examination and is insufficient for its development.

In the beginning 1990s, S. F. Bychkova emphasized that knowledge of basic laws of integration processes in forensic science makes possible to consciously their management, and this accelerates transition from the level of multidisciplinary examinations to the level of multidisciplinary methods, therefore, contributes to creation of forensic science branches of knowledge. Under such conditions, acquisition by one person of the required amount of knowledge from several types of forensic examinations

will contribute to mutual enrichment of knowledge in various fields of science ²¹.

It is worth emphasizing that methods for conducting forensic fire investigations should be available to a wide range of experts: it is studied by evidence subjects and it is the most effective program of categorical or alternative operations of choice or application in the form of a system of methods, techniques and technical means designed to solve the tasks of forensic research by studying objects related to forensic examination subjects. In addition, methods should perceive and simultaneously present studied information, as well as contain specific criteria for evaluating achieved results. Such methods are extremely necessary, since the material evidence received for research by forensic expert during fire investigation is quite diverse in nature and purpose.

Forensic expert practice indicates during fire investigation, objects, devices and devices of electrical purpose are most often investigated, since the most common causes of fires are violations of the rules of installation and operation of electrical networks or electrical installations and the use of emergency equipment a. Forensic expert finds out possibility of availability of electrical equipment at the location where the fire originated and, based on obtained data on components of fire load, determines thermal parameters for ignition of a certain material (substance) ²².

20 Дулов А. В. Модели расследования преступлений. *Современные достижения научно-технического прогресса в борьбе с преступностью* : тез. докл. науч.-практ. конф. Минск, 1992. С. 36—39.

21 Бычкова С. Ф. Становление и тенденции развития науки о судебной экспертизе. Алматы, 1994. С. 98.

22 Загальні положення інженерно-технічних досліджень небезпек у життєдіяльності : звіт про НДР № держреєстр. 0108U000447 ; наук. керівн. О. Ф. Дьяченко / ХНДІСЕ. Харків, 2009. С. 158.

Analyzing possibility of availability of individual objects in the fire center and comparing their location in space with the materials of the fire load, the expert programs verification of expert versions regarding involvement in ignition:

- red-hot to the value of ignition source of installation body or heating element of the electrical appliance or the red-hot core of electrical conductor;
- phenomenon of excessive current transient resistance in places of contact connections of electrical conductors;
- overloading of power grid and individual elements of electrical appliances;
- discovered static (atmospheric) electricity;
- electric sparks or an electric arc (in availability of emergency modes in the electrical installation or lightning in environment).

Physical evidence of electrical engineering purpose includes:

- power lines, cables, switching devices (circuit breakers, starters, plug connectors, etc.);
- electric heating and electric lighting devices (tiles, kettles, soldering irons, irons, kettles, floor lamps, sconces, etc.);
- electric motors, transformers;
- protection elements (circuit breakers, fuses).

According to geometric shapes, physical dimensions, detailed signs, thermal and mechanical damage of studied objects, the reason(s) for occurrence of changes are found out. If necessary, forensic experts carry out microscopic researches on damage sites, that make

possible to more accurately identify the details and structure of fusions, determine the signs and limits of a short circuit in the form of small drops of metal in the fusion zone. According to external inspection, availability of breaks in fuse inserts, electrode wires, and electrical conductors is established.

In some cases, in order to successfully answer questions posed to forensic expert, objects of electrical engineering purpose are investigated experimentally, when determining:

- protective characteristics of automatic switches and fuses;
- heating time and temperature of various parts of electronic heating, lighting devices, power equipment;
- ignition possibility of various materials from heated surfaces of these electrical devices.

Forensic experts conduct experimental researches (if possible) using analog samples to ensure the physical evidence storage, subject to compliance with the rules of safety and fire safety. The scope and sequence of experimental researches on electric heating devices and lighting equipment are determined in accordance with guidelines requirements or forensic methods ²³. Here are some examples of such forensic researches:

- during tests of electrical protection devices, experts check the tripping of disconnectors. Tripping current is determined by gradually increasing the current through the disconnector to the value at which it will trip. The measurements are repeated 5 times, whereupon average arithmetic value of the triggering current is calculated;

23 Коротких Н. И., Мартынюк В. И. Указ. соч. ; Нам А. Г. Установление признаков горения древесины пола ... ; Его же. Методические подходы

- while determining critical current of the fuse, it is necessary to assume that fuse will melt at this current value within 1–2 hours (during the time required to reach the required temperature). The value of melting current of metal wires is determined according to appropriate tables (depending on the type of metal and wire thickness);
- for checking disconnection of electrical network by protective devices, determine the value of the short-circuit current in the electrical network, assess the compliance of thickness of electrical conductors with heating conditions, carry out appropriate electrical engineering calculations.

During forensic fire investigation, forensic expert receives data from relevant proceedings and based on instrumental research results of provided facilities:

- detects availability of traces of emergency operation mode of electrical installation components;
- evaluates whether they are related to origin of initial burning, indicated by an employee of the fire and rescue unit or a specialist of research and testing laboratory of emergency services.

Finding out emergency mode mechanism, forensic expert determines conditions that preceded its occurrence and component involvement of electrical installation in the formation of a dangerous thermal factor at the location of fire source.

If there are remelting traces on the cores of conductors, remelting nature, as well as conditions under which it occurred, are determined with the help

of metallurgical researches. If melting of conductor took place in environment conditions that existed before the fire start at the location of its source, then based on obtained data, forensic expert assesses involvement of this phenomenon in formation of the ignition source of electrical nature and the fire mechanism.

Therefore, emergency mode involvement in the electrical installation in fire occurrence is considered justified if, based on research results, forensic expert determined:

- emergency mode existence in the electrical installation;
- fire location spatially coincides with the thermal detection location of the emergency mode;
- occurrence time of emergency mode preceded the time of fire occurrence;
- heat pulse of emergency mode was sufficient to ignite combustible system.

While carrying out multidisciplinary forensic fire investigations, there are not only cases when it is necessary to apply separate physical and chemical methods. For example, the analysis of objects using X-ray structural and X-ray spectral research methods makes possible to determine qualitative and quantitative composition and structure of the studied objects, without damaging or changing the structure of the studied objects of original sample that can be further studied using other methods or used as a reference sample.

If forensic expert finds out necessity of experiment conducting, a project is drawn up in advance; mentally analyze possible options for initial data and conditions; evaluate expected results from the standpoint of their impact on obtaining answers to the posed questions.

Let us focus separately on issues contained in the investigator's decision on the appointment of a forensic fire investigation. According to the task of the investigator or the court, forensic expert may ask questions regarding:

- availability (origin, nature, etc.) of thermal damage to building structures, equipment, furnishings;
- nature (degree, duration, etc.) of thermal impact on materials, substances, products;
- purpose (condition) of technical means and materials, etc.

At the same time, we should emphasize that resolution on forensic examination assignment cannot contain such questions as, see below:

- "Which fire safety rules were violated?";
- "Did the authorized person take all measures to ensure fire safety? If not, which ones did he/she not use?";
- "Is the cause of fire arson or careless handling of fire?"

Scientists have repeatedly noted that issues submitted for examination should be specific and directly related to the event that is being investigated or which circumstances are being investigated (in particular, in the case of forensic fire investigations). It happens that forensic expert receives content of the proceedings (without material objects that the law enforcement agencies should have removed from the fire scene to conduct a forensic fire investigation) and has to answer only one question: "*What is the cause of the fire?*", that makes forensic expert work impossible, since he does not have

the right to analyze investigative versions and testimony of witnesses, because this goes beyond specific expertise application and involves assessing the situation in the field of jurisprudence, that forensic expert is categorically forbidden to do ²⁴.

In addition, forensic expert practice indicates that informativeness of forensic research cannot be sufficient to reliably establish the fire cause due to:

- non-obviousness of its occurrence and, in connection with this, some hypothetical character of pre-fire situation;
- lack of reliable quantitative methods for assessing the fire situation;
- destructive effect on material evidence and fire traces of thermal factors and actions of fire departments to eliminate the fire that reduces effectiveness or makes impossible to analyze the post-fire situation ²⁵.

We emphasize: the expert's conclusion in such cases may not have evidential value. Under such conditions, before appointing a forensic fire investigation, we consider it expedient to consult in advance with a specialist in the relevant field of knowledge regarding selection and wording (formulation) of questions that are put to the solution of the forensic fire investigation.

It should be noted while conducting forensic fire investigation, forensic expert can find out only certain circumstances that contributed to the occupation and further fire development that should be concluded without specifying subjects that can be involved in this event due to their official duties, as this is beyond forensic

24 Шмерего О. Б. Зазнач. твір. С. 438—439. DOI: 10.33994/kndise.2020.65.42 (date accessed: 25.04.2023).

25 Загальні положення інженерно-технічних досліджень небезпек ... С. 112—113.

expert competence: only an investigator or a court has the right to make a decision about involvement (non-involvement) of a person (persons) in the event under investigation.

Sometimes in conclusions about impossibility answering to the question, forensic experts do not indicate the reasons for such a refusal that is unacceptable. In this case, the reason(s) for impossibility of giving an answer(s) to the question are given in an understandable form, referring to the conducted forensic researches, if their volume is significant. Approximate reasons for impossibility of answering to forensic examination questions:

- insufficient number or lack of the expert's objects or initial data necessary to solve the issues (when the expert's request was left without appropriate attention);
- objects provided to forensic expert for research are of low quality or unsuitable for research;
- there is no appropriate expert methods or guidelines for this forensic research, or there is a lack of necessary equipment and facilities;
- question is formulated incorrectly is not directly related to the event under investigation or concerns its legal assessment.

Forensic expert's refusal to carry out a forensic investigation into establishing fire circumstances, when its cause is likely to be complex electronic equipment, special technological equipment, exothermic processes of reactions of chemical substances, etc., is considered legitimate. In this case, it should be recommended to carry out a multidisciplinary forensic examination or initial technical, technological and chemical expert researches, necessary

to identify the facts of fire-hazardous operation of devices in emergency mode, aggregates regarding the parameters of heat and mass transfer during chemical reaction, etc. In the future, an expert in the field of forensic fire investigations can use the results of such researches to solve issues related to forensic examination entrusted to.

Separately, it should be noted that due to complexity of perceiving the expert's conclusion on the fact of a fire, forensic examination initiators the quite often rely too much on the expert's conclusion, releasing themselves from obligation to thoroughly and comprehensively evaluate it. A similar trend is threatening because forensic expert error can cause an error in the planning of further investigation or during the trial. We emphasize that the expert's conclusion (in particular, regarding the investigation of fires) belongs to the evidence source, but is not binding on investigating authorities.

Note that forensic expert, formulating conclusions based on the research results, cannot categorically state the fire cause (due to arson or negligence): such a statement is legal in nature, in other words, it involves establishing circumstances of both the event itself and the subjects associated with the fire, possible motives, etc. While fire investigating a conclusion should be assessed that indicate that it is not possible to resolve the investigation issue.

The expert's evaluation of the conducted research results is connected with the formation of conclusions regarding one of the main issues of the forensic conclusion fire investigation, namely: establishing a cause-effect relation between emergency mode in the power grid and fire occurrence. This is done by analyzing, summarizing and

evaluating the results of research of all forensic examination objects (provided that the question of the location of the fire source is resolved). Criteria for evaluating conducted research results by forensic expert:

- 1) availability of a dangerous process (regime) signs;
- 2) availability of fire-hazardous process (regime) factors;
- 3) coincidence of detection location of fire-hazardous factor with the fire center;
- 4) possibility of combustion from a certain fire-hazardous factor (ignition source);
- 5) justified exclusion of other possible factors of fire occurrence (ignition sources)²⁶.

Evaluating research results, for example, according to criterion 1, general negative conclusion can be made only if all necessary data (materials) are provided for research, on which basis of possibility of fire-hazardous process (fire-hazardous circumstances) can be unequivocally rejected before the fire occurs.

According to criterion 2 (on the basis of detected signs and characteristics of fire-hazardous circumstances), possibilities of dangerous process development before occurrence of fire-hazardous factors are evaluated.

Criterion 3 provides for coincidence of location of fire hazard factors with fire source location.

Criterion 4 assesses ignition possibility of substances, materials and products near the occurrence location of fire-hazardous factors. While experimental research under the same conditions, ignition effect cannot be observed during all attempts

(due to influence of random factors that cannot be simulated), so essence of criterion 4 is to determine principal possibility of igniting a combustible material.

Criterion 5 provides if there are two or more causes of fire (ignition sources), it is not possible to provide categorical conclusion in favor of one of them.

Depending on the number of criteria established by forensic expert, the expert forms conclusions regarding cause-effect relation between the fire-hazardous process and fire occurrence or regarding prerequisites, which combination caused fire occurrence. At the same time, the following principles should be followed:

- if available all the above-mentioned criteria, the conclusion will be categorical about availability of cause-effect relation between the fire-hazardous process and fire occurrence;
- if available only criteria 1, 2 and 5, the conclusion can be probable;
- in default of criteria 1, 2, 3 and 4, the conclusion will be categorically negative about lack of a cause-and-effect relationship between fire-hazardous process and the fire.

We emphasize there are not rare cases when specialists of the research and testing laboratory of the emergency services are involved in expert studies, who have a special fire-technical education, but are not knowledgeable about special expert methods developed in specialized forensic expert institutions, which sometimes leads to incorrect conclusions. For example, the direct application of methods for determining the center of a fire by conducting instrumental research

26 Розробка методики з теоретичних та практичних основ проведення судових пожежно-технічних експертиз : звіт про НДР № держреєстр. 0118U000977 ; наук. керівн. О. Б. Шмерего / КНДІСЕ. Київ, 2019. С. 109—110, 282—283.

or building a schematic plan can lead an expert to a false conclusion regarding the location of the center of a fire, since the use of the mentioned methods makes it possible to determine only the place of the most intense and long-lasting thermal effect of the fire, geometric center of the area affected by the fire, etc.

We note that tasks of forensic fire investigations are diagnostic in nature: during their solution, an important place is occupied by mathematical modeling of processes related to heat and mass transfer, transient modes of electrical circuits and devices. Since there is a lack of expert methods in this field of research, forensic experts use models that are usually used when solving technical tasks (design, construction, training, etc.). However, under such conditions, these models do not fully meet specific requirements associated with emergency non-standard, processes and phenomena caused by the practice of occurrence and development of fires. Thereby similar models have shortcomings and gaps, and during their application, inaccuracies can be assumed that will lead to drawing of erroneous conclusion by forensic expert.

Unfortunately, while conducting forensic fire investigations, professionals make mistakes due to subjective reasons, namely: insufficient professional competence of forensic expert, directly related to ignorance of the latest modern developments in this field or insufficiently active information exchange of best practices between forensic science institutions of various ministries; difficulties in accessing new methodological developments.

At the same time, investigative and forensic practice testify to the fact there are not rare cases when specialists who do not have the appropriate higher technical

education and/or skills in working with modern tools are not familiar with the latest research methods are engaged to conduct forensic fire investigations. In addition, they do not have the skills to methodically correctly conduct a forensic experiment that (given the complexity and specificity of forensic fire investigations) is important for simulating the processes that actually occurred during fire.

We emphasize the fact that forensic expert conducts research, which basis is the knowledge he has acquired thanks to higher education in the fire engineering field, about processes related to occurrence and development of fire. During a forensic fire investigation, forensic expert who is not sufficiently familiar with the latest achievements in this field can apply outdated methods, not use modern technical and special means (for example, to detect traces of flammable liquids, sprinkle separate areas of surfaces with fat- and alcohol-soluble dyes; search for the reasons for the melting of wires by repeatedly bending them, etc.): the result of such “researches” is the loss of valuable information, which on could further have evidential value.

Errors are caused by incompleteness of forensic research, especially while solving complex tasks that require the use of modern devices, equipment and methods.

The following deficiencies can often be observed during forensic a fire investigations and preparation of forensic expert conclusion:

- non-use of methods from the Register of methods of conducting forensic examinations of the Ministry of Justice of Ukraine;
- description incompleteness and inaccuracy of researched objects, samples and other materials;

- use of household terminology;
- lack of references to reference and normative materials and literary sources during classification researches and solving issues regarding compliance with requirements of regulatory documents;
- insufficient coverage in conclusions of conditions for conducting experimental research, although these conditions largely determine obtained results;
- insufficient substantiation of conclusions complicating their evaluation by investigation or the court.

Conclusions

Problematic aspects of individual stages in the investigation of fire circumstances are outlined; recommendations were formulated regarding requirements for scene inspection of the incident and the circle of expert witnesses who should participate in this inspection, regarding specifics of the appointment of forensic fire investigations and further evaluation of conducted research results ; attention is focused on errors that a forensic expert can make during forensic fire investigation, and the causes of such errors. It has been proven that methods and expert techniques determined by investigative-expert situation at each stage of investigation should be used in fire investigation.

It is emphasized that following criteria should be used to evaluate the forensic fire investigation results and form an expert's conclusion: availability of dangerous process signs; availability

of fire-hazardous process factors; the coincidence of the place of detection of fire-hazardous factor with the fire center; possibility of combustion from such a fire-hazardous factor; justified exclusion of other possible factors of fire occurrence.

In order to prevent erroneous forensic expert conclusions, the need to update to modern level of development of science and technology and to unify methodical guides for conducting forensic researches on all possible objects at each stage of the fire investigation has been identified. Errors that are most often assumed during the execution of forensic a fire investigations and preparation of the expert's conclusion are highlighted.

Further scientific explorations. Increasing efficiency and quality of the use of multidisciplinary forensic fire research on fires requires further development of methodological aspects of integration forensic research (for example, individual methods of integration research: situational analysis, modeling, forensic reconstruction). At the same time, it is necessary to improve the procedural component, since the current legal framework does not fully correspond to specifics of modern state of the forensic science institute and inhibits its development.

Проблемні аспекти призначення та проведення пожежно-технічної експертизи

Ірина Петрова, Ігор Богданюк

Автори мали на меті окреслити проблемні аспекти окремих етапів у розслідуванні обставин пожежі; сформулювати рекомендації щодо вимог до огляду місця події й кола обізнаних осіб, які мають брати участь у цьому огляді,

щодо особливостей призначення судових пожежно-технічних експертиз і подальшого оцінювання результатів проведеного дослідження; звернути увагу на помилки, яких судовий експерт може припуститися під час пожежно-технічного дослідження, і причини таких помилок. Для досягнення поставленої мети застосовано загальнонаукові та спеціальні наукові методи, зокрема, аналіз, синтез, аналогію; формально-логічний; логіко-юридичний; системно-структурний. Доведено, що для розслідування пожежі слід застосовувати методи й експертні методики, зумовлені слідчо-експертною ситуацією на кожному етапі розслідування. Із метою запобігти помилковим висновкам експерта констатовано потребу актуалізувати до сучасного рівня розвитку науки та техніки й уніфікувати методичні рекомендації та експертні методики із проведення експертних досліджень усіх можливих об'єктів на кожному з етапів розслідування пожежі. Наголошено, що оцінювати результати експертного пожежно-технічного дослідження й формувати висновок експерта слід за такими критеріями: наявність ознак небезпечного процесу; наявність пожежонебезпечних чинників процесу; збіг місця виявлення пожежонебезпечного чинника з осередком пожежі; можливість виникнення горіння від такого пожежонебезпечного чинника; обґрунтоване виключення інших можливих чинників виникнення пожежі. Виокремлено помилки, яких найчастіше припускаються під час проведення судових пожежно-технічних експертиз і оформлення висновку експерта.

Ключові слова: судовий експерт; судова пожежно-технічна експертиза; огляд місця пожежі; експертне дослідження; оцінювання висновку експерта; об'єкти експертизи.

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