Fire Safety External Audit Procedure

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Abstract. The paper examines fire safety audit as well as algorithm, main functions and aims of its performance. Existing procedure for evaluation of fire risk is investigated. Methodology was developed for external audit of safety systems in public mass-attendance facilities. It also covers new types of outsourced fire safety services aimed at ensuring fire safety being a fundamental aspect of guaranteed safe operation, economic stability of a company and confidence in the future.

1. Introduction
Fire safety status of buildings and structures can be defined by the relevant norms approved by laws of the Russian Federation. Facility is considered safe in case all the requirements of fire safety are complied with, risk of fire occurrence and propagation of flame is reduced to a minimum.

The article reviews the problem of the absence of developed procedure to perform expert examination of fire safety conditions at public facilities under protection.

Novelty of investigations' results, fullness and validity of using available literature on the subject lie in the development of algorithm to perform external audit of fire safety by specialized companies. Proposal is given regarding the indicative range of questions to be covered while rendering such services.

2. General terms and designation
A certain procedure - independent evaluation of fire risk values or fire safety audit - is conducted to establish compliance of capital construction facility with the requirements of fire safety, universally accepted legislative documents. Fire safety audit includes a set of actions which ensure facility protection level against ignitions [3].

Main target of independent evaluation of fire risk is to estimate and develop actions aimed to increase protection level of human health, material assets as well as areas from fire and its consequences.

This procedure plays a key role in the facility operation because set of actions taken within its framework covers a comprehensive range of essential processes:

1. Procedure of fire safety analysis of a facility is established by norms and it includes:
   • examination of a facility according to the established norms;
   • evaluation of space-planning and structural solutions of a building;
2. Definition of design values of fire risk and their comparison with the allowed regulated values.
3. Control of correspondence of technical condition of a building with the requirements of regulations and standards.
4. Elaboration of measures to ensure fire safety while using equipment and carrying out technological processes.

Most facilities subject to repair or rearrangement require performance of fire safety audit for further safe operation as well as minimization of expenses needed for its assurance. Aside from such buildings and structures, carrying out such procedure is efficient for:

- facilities with high attendance;
- facilities pertinent to critical infrastructure category;
- facilities neighboring with industrial facilities of categories A, Б, В according to fire and explosion hazards.

3. Fire safety audit procedure

Expert organizations are authorized to perform independent evaluation of fire risk values. This procedure ensures protection against corruption of state fire authorities and it allows to save budget of a company by complying with all fire safety rules. The basis for commencing independent evaluation of fire risks is the execution of contract with the owner or the renter of facility.

Fire safety audit of buildings and structures is performed in several stages which are regulated by legislative documents.

The analysis of design, technical and other documentation is performed in the course of fire safety audit. All plans and drawings are examined to define "vulnerability" of system that ensures fire safety. First and foremost, record is made regarding:

- absence of emergency exits, reduction of capacity of emergency exits and evacuation routes;
- malfunctioning, incompleteness of fire fighting systems;
- violation of requirements to ensure prevention of fire propagation or generation of fire outbreak (absence of fire partitions, non-conformity of fire-resistance degree of a building or fire-resistance ratings of bearing structures, etc.).

At this stage, if needed, the elements of fire fighting systems are tested: smoke dampers, fire extinguishing complexes, fire staircases, etc. Apart from that, structures and finishing materials are tested, required calculations are made pertinent to definition of possible risks of fire occurrence and fatalities.

It is noteworthy that while evaluating fire risk of buildings with various fire-resistance degrees and with designated safe areas it is necessary to specify the value - "average frequency of fire occurrence considering functional profile of buildings along with their main fire and technical properties" [13]. Intermediate results of facility examination are discussed with the Client in order to make decisions regarding the organization of measures and actions which ensure fire safety of the facility.

Final result of fire audit service is the development and issuance of conclusion of an independent evaluation of fire risks with statement of findings and results of the work done. Conclusion includes data regarding possible risks of fire occurrence and fatalities, estimated value of fire damage and other information.

Conclusion is certified with a stamp of expert organization and signatures of specialists that carried out the procedure. Conclusion is also mandatorily registered at the regional authorities of Russian Ministry of Emergency Situations (EMERCOM) with assignment of an individual number.
The issued conclusion of an independent evaluation of fire risk has an influence on the category of risk of Facility under protection, i.e. in standard situations, it is recommended to reduce the category of risk, which consequently has an influence on the frequency of scheduled inspections by state fire inspectors, i.e. reduction of the amount of such inspections.

4. Fire safety audit: forms, targets, tasks, functions
Currently, evaluation of compliance of a building with the requirements of fire safety is carried out in various forms based on needs of society and economy. Each room, public area of a facility is subjected to the risk of fire occurrence if all hazardous fire factors are not identified and relevant safety measures are not taken [2].

Commitment to complying with the fire safety rules helps to preserve human lives, health, their property and material assets.

Fire safety of a facility is considered ensured in case all fire safety requirements are fully met and fire risk is minimal. It is required to carry out an independent evaluation of fire risk in order to give an expert evaluation of facility under protection for its compliance.

Fire risks might not be fully eliminated but they can be minimized due to fire safety checks done by relevant auditing organizations.

Audit can be carried out in reference to a company, real estate property, fire fighting means and systems, equipment and products. Expert organizations are entitled to carry out fire safety audit and issue conclusions.

Fire safety audit is performed to become aware of the real state of affairs in a company as well as increase the safety level of a facility, identify and rectify violations and faults of fire safety system of facility under protection in due time. Company management provides and defines time frame of fire risks evaluation as they may deem appropriate.

Investigation gives evaluation whether management is scrupulous about fire safety instruction regulated by legislative framework of the Russian Federation. The analysis of the documents which characterize fire safety is reviewed for that purpose. Buildings are examined in order to identify the level of compliance with fire hazard requirement and the route of possible start and propagation of potential fire. Measures to rectify violations are also recorded.

Close cooperation between service provider and client is required to render efficient fire audit service. As per evaluation rules, interaction between client and fire auditor is expressed through the client providing the auditor with documents which indicate fire hazard conditions of a facility, as well as allowing employees of an expert organization or other individuals specified by an expert organization the access to examine the territory of facility under protection.

Pursuant to Federal law No. 123-ФЗ dated 22/07/2008 “Technical regulation of fire safety requirements”, article 144, part 2 defines the procedure for evaluation of facility under protection compliance with the established fire safety requirements by means of an independent evaluation of fire risk [1].

Main functions of fire safety audit may include:
- identification of possible occurrence and development of fire and impact of fire hazards on people and material assets;
- examination of operability and proper functioning of fire protection, fire-fighting, public address, ventilation, smoke removal systems available in the building;
- development of optimum safety diagram and maximum protection measures depending on identified fire risks;
- fire risks are calculated;
- analysis of documentation (fire safety certificates, designs of fire safety systems, act of operability of fire protection systems, etc.) available at facility for completeness and compliance with the regulatory requirements of fire safety.

Let's have a more detailed review of the algorithm of fire safety audit procedure for a building.
1. Receipt and review of client’s request for an independent evaluation of fire risk. The request for fire safety audit shall contain:
   - data of the owner or renter of the facility to be audited (building);
   - constituent documents, details;
   - name of a facility and its actual data: address, total area of buildings, fire safety class, number of people in each room.

After review of the request, a contract is also executed with an expert organization which prescribes timeframe, price and payment procedure, work terms, algorithm for submission of conclusion, and auditing services are paid.

2. Documentation analysis.
   At this stage, client shall provide the expert organization with design, procedural and technical documentation which characterizes fire safety of a building.

3. Audit of facility under protection.
   Building is examined to obtain unbiased information regarding fire safety conditions at this facility under protection. Possibility of fire occurrence and development is identified. Impact of fire hazards on people and material assets is evaluated. Evaluation is also made regarding the compliance of this building with fire safety norms and requirements established in the Russian Federation.

4. Additional expert appraisals and investigations, independent calculation of fire safety risk.
   Calculations of fire risk evaluation can be additionally made and required investigations and expert appraisals can be performed by employees of the expert organization or by assigned specialists of fire test laboratory.

5. Results processing and preparation of a report.
   At this stage, results of all measures taken are processed, documentation on independent fire risks evaluation is prepared, conclusion is drawn regarding compliance of the building with regulated fire safety requirements and conclusion is made whether terms of compliance with these requirements are respected or not.

6. Issuance of conclusion.
   Based on the results of fire safety audit, a conclusion is prepared which mandatorily specifies details of parties involved in fire safety audit, data for all the available facilities which were involved in the audit, methods and ways of fire hazard evaluation. In case fire safety requirements are not complied with, measures (rectification plan) are developed to ensure fulfillment of conditions which will allow for compliance of facility under protection with fire safety requirements.

5. Requirements to expert organizations and changes in legislation
   As of 25 November 2018, EMERCOM Order No.660 dated 25/11/2009 according to which all expert organizations providing independent evaluation of fire risks (hereafter IER) shall be accredited has become no longer valid.

   Currently, there is no document which would require accreditation. This is also confirmed by clarification letter of EMERCOM of Russia.

   Each expert organization providing independent evaluation of fire risk shall employ an expert for whom it will be a primary employment [7].

   Apart from that, one of core activities of an expert organization shall be specifically an independent evaluation of fire risk (fire safety audit).

   IER experts shall pass qualification. Each expert shall pass qualification to prove possession of specific knowledge of fire safety which is required for an independent evaluation of fire risk. This requirement is established by the Decree of the RF Government “On qualification of officials engaged in fire risk evaluation [11].

   In order to pass qualification, an expert shall meet the requirements:
   - higher or secondary professional education majoring in "Fire safety";
   - work experience in the field of "Fire safety" of not less than 5 years;
• specific knowledge in the field of fire safety required for fire risk evaluation;
• experience of filling the position with the right to sign conclusion of fire risk evaluation in an organization engaged in fire risk evaluation.

Qualification shall be passed every 5 years.

Russian EMERCOM Order No.23 dated 18/01/2019 "On approval of the decree about qualification committee, requirements to holding qualification exam, requirements to preparing and maintaining register, qualification application form, qualification certificate form stipulated by decree of the Russian Federation government No. 602 dated 26/05/2018" (Registered No. 54328 as of 10/04/2019) approved [5]:

• new qualification rules for officials engaged in fire risk evaluation «Decree of the Russian Federation Government No. 602 dated 26 May 2018»;
• requirements to qualification exam for specialists that will perform IER;
• decree on qualification committee of territorial authority of Russian EMERCOM;
• requirements to preparing and maintaining register of IER experts;
• qualification application form and qualification certificate form for an IER expert.

Regardless of previous qualifications, IER experts shall be requalified all over again pursuant to EMERCOM Order No. 23 dated 18/01/2019.

It is also confirmed by Russian EMERCOM letter No. 19-16-300 dated 8 February 2019 "On review of request": ".qualification tests results of IER experts qualified under Russian EMERCOM order No. 660 dated 25/11/2009 and decree of RF government No. 304 dated 07/04/2009 are not acknowledged" [5].

Official Russian EMERCOM website displays "The list of questions for qualification exam to check whether officials engaged in fire risk evaluation that applied for qualification have specific knowledge in the field of fire safety required for IER.

List of questions for IER qualification exam contains 890 questions pertinent to fire safety requirements, functioning of fire-fighting systems, approval of design documentation with state fire authorities, etc.

Questions are compiled in accordance with it. 16 of "Qualification rules for officials engaged in fire risk evaluation [12].

6. Fire safety outsourcing

In the recent years, the so-called fire safety outsourcing has gained greater popularity - independent expert examination of fire safety status of facilities under protection or fire safety audit by external experts.

It is hard to find time and competent specialists in modern business in order to arrange well-managed work ensuring fire safety. The most suitable way-out in this case is to employ fire safety outsourcing. (Outsourcing is transferring certain production functions to be performed by another company specialized in the relevant field).

Such service is rendered for organizations, companies with the aim of ensuring fire safety being a fundamental aspect of guaranteed safe operation, economic stability of a company and confidence in the future [10].

Outsourcing can be full and partial as desired by Client [4].

Outsourcing scope (full scope) includes:

• performing functions of fire safety inspector;
• carrying out fire safety analysis of a company;
• developing documentation: orders, instructions, decrees, and other local regulations that establish the required fire safety arrangements in a company;
• preparing fire safety declaration for a company
• developing and (or) correction of fire evacuation plans;
organizing fire safety briefings and basic fire safety course and monitoring their attendance by all employees;
consulting and informing employees of a company including its manager regarding fire safety issues;
organizing and performing fire trainings with employees;
participating in investigation, registration and recording of fire cases, ignitions, fatalities and injuries caused by fire, estimation of fire-caused damage to property in a company;
monitoring of keeping fire safety means and systems operable including primary fire-fighting means;
testing internal fire hose reel cabinets for water supply and rewinding fire hoses;
preparing reports on actions taken to ensure fire safety and work plans for company manager;
conducting fire-fighting public awareness campaign;
analyzing fire safety violations done by employees and other individuals at facility under protection;
monitoring execution of improvement orders given by state fire authorities;
optimizing costs for fire safety measures.

The following questions can be raised at the discretion of experts during external fire safety audit [8, 9]:

1. Does a building located at the address:.... (indicate the address) comply with fire safety requirements?
2. Do the interior finishing materials of a shopping centre located at the address:.... (indicate the address) comply with fire safety requirements?
3. Does public fire alarm and warning system in a building located at the address:.... (indicate the address) comply with fire safety requirements?
4. Does fire-fighting system of an office centre located at the address:....(indicate the address) comply with fire safety rules?
5. Do emergency exits and fire escape stairs of a shopping centre "......" (indicate the name) located at the address:.... (indicate the shopping centre address) comply with fire safety requirements?
6. Does the width of horizontal portions (less than 1 meter) of emergency exit routes between escalator and external wall ensure safe evacuation of people?
7. Does power supply system of a shopping and entertainment centre "...." (name) located at the address:.... (address) comply with fire safety requirements? If it doesn't comply then what the non-compliance is?
8. Does the location of emergency power supply (diesel generator) in a shopping centre "......" (shopping centre name) comply with fire safety rules?
9. Does the storage of combustible and highly-flammable materials at storage room No. (indicate number) located at the address (indicate the address) comply with fire safety requirements?
10. Was fire risk correctly calculated? If not then what the violations and non-compliances are?

Tentative package of fire safety outsourcing services is shown in Table 1 [6, 13].

| Item No. | Name of services | Due dates |
|----------|------------------|-----------|
| 1.       | Periodic checks of fire safety conditions at Client's facility and compliance of Client's employees with fire safety measures:  
- examination of fire safety conditions at buildings and structures of Facility under protection located at the address: ..... the Russian Federation,  
453102.  
- submitting an Act on fire safety conditions of facilities to Client;  | Once in six months upon Client's request |

Table 1. Package of Fire Safety Outsourcing services.
| Item No. | Name of services | Due dates |
|---------|------------------|-----------|
| 1.      | - checking compliance of Client's employees with relevant Fire safety rules of the Russian Federation;  <br> - developing Rectification plan for identified fire safety violations. | during the contract validity period |
|         | 2. Consulting on compliance with fire safety regulatory requirements.  <br> - consultation by an expert organization employee (verbal, written)  <br> - preparation of data and requests related to execution of fire safety regulatory requirements for fire authorities, Public prosecution office, city administration;  <br> - legal consultations on fire safety issues defined by Federal laws No. 294-ФЗ, 384-ФЗ, 184-ФЗ, 123-ФЗ, 69-ФЗ, SP, RF Code of Administrative Offences. | during the contract validity period |
|         | 3. Review the legitimacy of requirements from state fire authorities including measures suggested in their Improvement orders.  <br> - review correspondence received from state fire authorities - prepare written data for Client regarding compliance with regulatory requirements and federal legislation pertinent to fire safety measures specified in improvement order.  <br> - preparation of substantiated objections to fire authorities (data, letters) regarding discontinuation of ungrounded (illegitimate) items of improvement order by state fire authorities.  <br> - analyzing legitimate requirements of fire authorities' Improvement order and preparing suggestions for Client regarding execution of Improvement order with lower costs or with compensating regulatory and technical requirements of fire safety. | during the contract validity period |
|         | 4. Act in the name and on behalf of Client at State fire authorities regarding fire safety issues  <br> Presence of expert organization employee acting as Client's authorized representative for administrative issues (consistent with legislation currently in force) to provide:  <br> - consultation and information support regarding regulatory requirements of fire safety,  <br> - resolution of debatable issues regarding application of regulatory and technical requirements of fire safety.  <br> Preparation of written data for fire authorities (requests, reports, replies, queries, etc.) regarding fire safety as well as the results of checks performed. | during the contract validity period |
|         | 5. Preparation of facility for fire authorities' inspection.  <br> - review legitimacy of notification regarding control (inspection) by fire authorities, prepare (if needed) substantiated written data for fire authorities regarding legitimacy of inspection;  <br> - perform test inspection of fire safety conditions of buildings and compliance with fire safety arrangements by company employees. | during the contract validity period prior to inspection by fire authorities |
|         | 6. Act in the name and on behalf of Client for fire safety issues during inspections by Fire authorities  <br> - involvement (if needed) of an expert in the inspection;  <br> - collecting relevant evidence on compliance with fire safety regulatory | during the contract validity period |
| Item No. | Name of services | Due dates |
|---------|-----------------|-----------|
| 7.     | Act in the name and on behalf of Client during inspections of fire safety compliance by public prosecution authorities. | during the contract validity period |
|        | 1. involvement of a specialist of an expert organization during inspection; |
|        | 2. collecting relevant evidence on compliance with fire safety regulatory documents, abstracts from regulations and actual jurisdiction (etc.), Client's supporting documents on fire safety measures and providing it to public prosecution authorities. |
| 8.     | Review design documentation in relation to compliance of solutions made with the requirements of fire safety regulatory documents. | During the contract validity period |
|        | - review design and cost estimate documentation for construction, structural repairs, reconstruction and remodeling in terms of compliance of design solutions with requirements of fire safety regulatory documents; preparation of analysis and suggestions on reviewed documentation. |
|        | - prepare suggestions regarding possibility of taking some compensating interchangeable fire safety measures which don't contradict regulatory requirements of fire safety. |

Results of analysis made on fire safety system with indication of legitimacy of their application and possible solution options are shown in Table 2.

Table 2. Results of analysis made on fire safety system.

| Description of violation | Reference to requirement of regulatory document | Solution option(s) |
|--------------------------|-----------------------------------------------|--------------------|
| Door is opened not in the evacuation direction | SP 1.13130.2009 it. 4.2.6 Emergency exit doors and other doors in the means of egress shall open in the direction of an exit from a building. | Reverse door swing 1) Calculation of fire risks. 2) Structural correction (passage enlargement). 3) Measures to justify deviations during development of project-specific technical specifications. |
| Evacuation route width is 0.75 | SP 1.13130.2009 it. 4.3.4 Clear height of horizontal portions of evacuation routes shall be not less than 2 m, width of horizontal portions of evacuation routes and ramps shall be not less than: 0.7 m - for passage to single working places; 1.0 m - in all other cases. | 1) Structural correction (passage enlargement). 2) Measures to justify deviations during development of project-specific technical specifications. |
| There are rooms within the walls of staircase, however, door to these rooms does not comply the required fire-resistance rating | Internal walls of staircase shall have fire-resistance rating of not less than REI 90 (pls. see table 21 of Federal Law No. 123) for II degree of fire-resistance building (II degree is defined according to SP 2.13130.2012 depending on designation, number of floors and bay area). | 1) Structural correction (passage enlargement). 2) Measures to justify deviations during development of project-specific technical specifications. |
| Staircase is not separated from lobbies | SP 1.13130.2009 it. 4.2.7 Commonly, staircases shall have doors with devices for | Structural correction (doors arrangement). |
### Description of violation

| Description of violation                                                                 | Reference to requirement of regulatory document                                                                 | Solution option(s)                                                                                                                                 |
|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| with doors fitted with door checks and seals                                            | self-closing and ledge sealing.                                                                                     | 1) Calculation of fire risks. 2) Structural correction (passage enlargement). 3) Measures to justify deviations during development of project-specific technical specifications. |
| Heating system pipes located in staircase project at height less than 2.2 m reducing the width of evacuation passage | SP 1 it. 4.4.4 In staircases, it is not allowed to place pipes with combustible gases and liquids as well as locate built-in closets except for cabinets for utilities and fire cocks, open electric cables and wires (except for wires for low-voltage devices) for lighting of corridors and staircase, provide exits from freight elevators and hoists, as well as install equipment projecting from wall planes at height of up to 2.2 m from the surface of stair treads and landings. | 1) Calculation of fire risks. 2) Structural correction (passage enlargement). 3) Measures to justify deviations during development of project-specific technical specifications. |
| Kitchen is not separated with fire partitions                                           | SP 4. It. 5.2.6 Food units as well as parts of buildings, groups of rooms or separate production, storage and technical rooms (laundry rooms, ironing rooms, workshops, storage rooms, switchboard rooms, etc.) in class Φ1.1 and Φ1.2 facilities, except for category В4 and Д rooms, should be separated by fire walls not lower than type 2 (type 1 partitions) and floors not lower than type 3 (in 1 degree fire-resistance buildings - type 2 floors). | 1) Structural correction. 2) Replacement of fire doors with water curtains while developing PSTS.                                                |

### 6. Conclusions

Therefore, advantages of making various fire safety analyses will be that the owner of building (room) is provided with objective, reliable and unbiased information regarding compliance of facility protection with valid norms and rules of fire safety, detailed recommendations which allow to enhance protection of building and lower risk category of facility under protection.

This work provides methodology of external fire safety audit, it also reviews algorithm, main functions and aims of its performance. Existing procedure for evaluation of fire risk is investigated as well as most relevant issues of organizing fire safety outsourcing.

The result of investigation is the developed new procedure for objective, reliable information regarding compliance of facility protection with relevant norms and rules of fire safety, detailed recommendations which allow to enhance fire protection of building and lower risk category of facility under protection.

### 7. References

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