

Scientific article

UDC 614.841.334; DOI: 10.61260/2304-0130-2025-2-98-102

## CONDITIONS FOR INCREASING THE LEVEL OF FIRE PROTECTION OF WAREHOUSE TRANSSHIPMENT LOGISTICS COMPLEXES

Vagin Alexander Vladimirovich;

✉ Ragimov Anton Olegovich;

Sai Anna Romanovna.

Saint-Petersburg University of State Fire Service of EMERCOM of Russia, Saint-Petersburg, Russia

✉ [antonragimov96@mail.ru](mailto:antonragimov96@mail.ru)

*Abstract.* In modern conditions of intensification of logistics processes and an increase in the volume of warehousing and cargo handling, the issue of ensuring fire safety of warehouse transshipment logistics complexes is of particular importance. High storage density, the use of combustible packaging materials, complex engineering infrastructure and a high degree of automation create specific risks of the occurrence and rapid spread of fires.

Legal, technical and organizational measures are considered to improve the effectiveness of fire protection systems. Special attention is paid to the design, modernization of fire detection and extinguishing systems, personnel training, as well as the introduction of digital technologies for monitoring and response. The need for an integrated approach is emphasized, including risk analysis, regular safety audits, and adaptation to new technological and regulatory requirements..

*Key words:* fire safety, warehouse transshipment logistics complexes, fire protection analysis

**For citation:** Vagin A.V., Ragimov A.O., Sai A.R. Conditions for increasing the level of fire protection of warehouse transshipment logistics complexes // Supervisory activities and forensic examination in the security system. 2025. № 2. P. 98–102. DOI: 10.61260/2304-0130-2025-2-98-102.

### Introduction

Warehouse transshipment logistics complexes are an integral part of modern supply chains. Their effective functioning has a significant impact on the continuity of material flows. However, the high concentration of cargoes, including combustible ones, the intensity of technological operations and the versatility of facilities lead to increased requirements for fire safety. According to statistics, logistics facilities are among the most vulnerable in terms of the frequency and severity of fire consequences. The relevance of studying the conditions for improving fire protection is determined by the need to minimize risks to the lives of personnel, loss of property and the stability of logistics processes [1].

Federal Law №. 123-FL of July 22, 2008 «Technical Regulations on Fire Safety Requirements» (FL №. 123-FL) establishes mandatory requirements for conditions for improving fire safety, which also apply to warehouse transshipment logistics complexes. These requirements are reflected in the table [2].

Table

**Required conditions for fire safety improvement**

№	Requirements	Statute	Article
1	Ensuring compliance with fire safety regulations. Each building or structure must comply with established fire safety standards, including:	– functional fire hazard class (F5.1 – industrial buildings and fire departments, F5.2 – warehouse buildings and fire departments, etc.); – category of explosion- and fire hazard, determined depending on the materials being handled; – estimated fire load, structural materials and room layout	art. 4
2	Availability and serviceability of fire protection systems. Federal Law №. 123-FL requires facilities to be equipped with:	– fire alarm systems (FAS); – Notification and Evacuation Management Systems (NEMS); – automatic fire extinguishing installations (AFEI) in the presence of conditions prescribed in the regulations; – anti-smoke ventilation; – sources of fire-fighting water supply	art. 60, 61, 64
3	Providing escape routes and safe evacuation conditions. The law regulates:	– the number and width of escape exits; – maximum distance from any point to exits; – light and audio evacuation indicators; – evacuation time must be ensured without exceeding the required evacuation time	art. 89–92
4	Maintenance of systems in good condition and monitoring. Fire protection systems must:	– be serviceable and efficient around the clock; – be checked and tested regularly and be serviced according to established regulations; – have documentary evidence of inspections	art. 64, 82
5	Staff training and organizational measures. The organization's responsibilities:	– instructing employees on fire safety; – developing evacuation plans and actions in case of fire; – conducting training sessions at least once every six months; – appointing responsible persons who have been trained according to the programs agreed with the EMERCOM of Russia	art. 38, 83
6	Fire declaration. For facilities, it is mandatory to develop and register a fire declaration, in which:	– calculated fire load indicators are indicated; – compliance with safety standards is confirmed; – list of risk mitigation measures is recorded	art. 64.1

If it is impossible to ensure compliance with certain requirements (for example, on evacuation distances), it is allowed to (Articles 6, 37 [2]):

- application of alternative technical solutions based on fire risk calculations;
- conducting an independent fire risk assessment with a conclusion [2].

Modern security challenges require a shift from reactive to proactive strategies based on risk assessment, technological equipment, and continuous employee training. The development of an effective fire protection system at logistics facilities should take into account both regulatory requirements and individual features of architecture, technological processes and functional purpose of each facility.

**Conditions for increasing the level of fire protection****1. Improvement of legal regulation and regulatory framework.**

The legal provision of fire safety for warehouse logistics complexes is based on compliance with the requirements of Federal Law №. 123-FL [2], as well as existing codes of practice such

as SP 484.1311500.2020 [3], SP 485.1311500.2020 [4], SP 486.1311500.2020 [5], SP 7.13130.2013 [6], etc. However, in practice, the regulatory framework requires not only compliance, but also adaptation to the specific conditions of the facility.

To increase the level of protection, it is necessary:

- conducting regular analysis and updating of regulatory documentation applied to a specific facility (sec. III Rules of the Fire Protection regime (Decree of the Government of the Russian Federation dated September 16, 2020 №. 1479 «On Approval of the Rules of the Fire protection regime in the Russian Federation» (Resolution №. 1479) [7]);

- development of internal regulations and instructions supplementing federal requirements, taking into account the specifics of logistics operations (Clause 6 of Article 4 of Federal Law №. 123-FL [2]);

- legal consolidation of responsibility for fire safety violations, including sanctions and disciplinary measures [8].

It is important to develop special technical specifications (STS) for large and highly automated warehouses, where standard standards are not always directly applicable.

## 2. Engineering and technical re-equipment and design.

Effective engineering and technical protection should be provided at the design stage of the logistics complex, as well as provided during operation through equipment modernization. The main directions are:

- fire detection systems: installation of addressable analog fire detectors, combined sensors (smoke, temperature, flame), integration with video surveillance systems and smoke behavior analysis [3];

- automatic fire extinguishing systems: water (sprinkler and drainage systems), gas, aerosol and powder installations. It is especially important to protect shelving systems and overload areas where the risk of fire is increased. [4];

- smoke protection: exhaust and back-up ventilation systems, automatic smoke extraction hatches, air vents and locks in loading areas [6];

- reliable power supply and redundancy: short circuit protection, emergency lighting, autonomous power supplies for security systems [9].

It is recommended to implement an automated fire protection control and data collection system based on SCADA (Supervisory Control And Data Acquisition) or BMS (Building Management System), which allows real-time management of all security elements.

## 3. Fire safety organization and personnel training

In accordance with Resolution №. 1479, organizational measures include a set of measures to create a sustainable safety culture and prepare employees for emergency situations. These include:

- development and approval of instructions on how to act in case of fire for each structural unit (paragraphs 2, 4, 5, 11, 15, 19);

- creation of volunteer fire brigades, providing them with the necessary equipment (paragraph 12);

- regular training alarms, including evacuation simulations taking into account various scenarios (night time, power outage, smoke screen) (paragraphs 10, 19, 20);

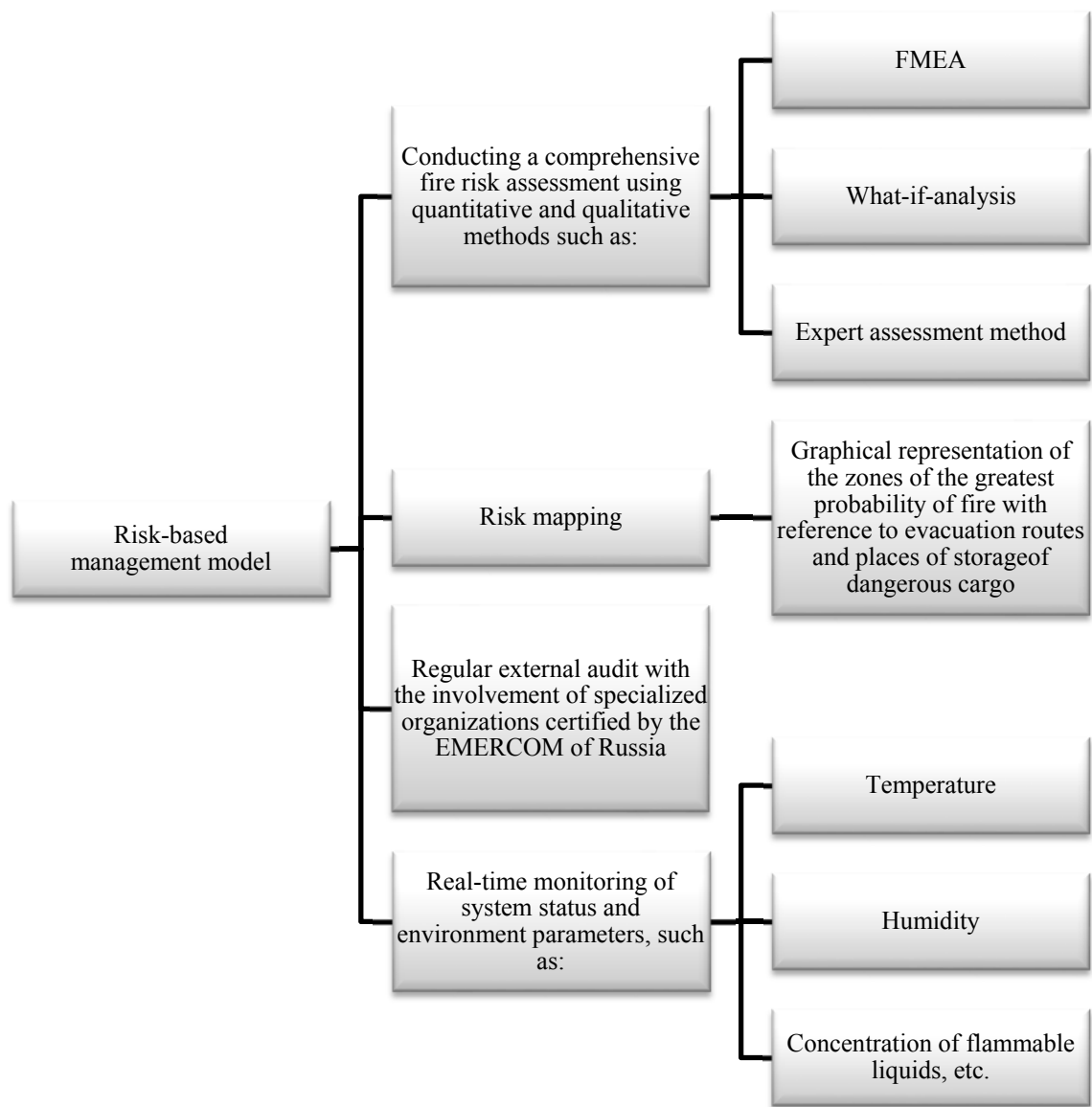
- staff training in working with primary fire extinguishing equipment (fire extinguishers, fire hoses, cranes) (paragraphs 17, 23);

- appointment of those responsible for the fire-fighting condition of buildings and maintenance of systems (paragraphs 15, 24, 25) [7].

Special attention should be paid to the training of drivers and loader operators, as they work directly in high-risk areas.

## 4. Implementation of a risk-based approach and regular audit.

The transition to a risk-based fire safety management model of the protection facility allows you to focus resources on critically vulnerable areas (fig.).



**Fig. Risk-based management model of the object of protection**

The use of software for modeling the spread of fire and smoke (for example, FDS – Fire Dynamics Simulator) allows you to increase the accuracy of design decisions and evacuation calculations [1].

#### 5. Application of digital and intelligent technologies.

Digitalization of fire protection is a modern vector of security development of logistics complexes. Promising areas are:

- predictive analytics systems: predicting risk based on the analysis of data on temperature and chemical anomalies obtained from IoT sensors (Internet of Things);
- integration with the digital twin of the facility: creation of a 3D model of the warehouse with data on the location of all systems and potential sources of danger;
- mobile applications and chatbots: tools for notification, evacuation and communication with emergency services;
- use of drones and robots: to survey hard-to-reach areas in case of fire, deliver extinguishing agents and assess the situation.;
- video analytics and artificial intelligence systems: analysis of the movement of personnel and equipment, detection of fire safety violations, monitoring of blockages of escape routes [10].

The integration of all components into a single system allows quick management decisions and coordination of service operations online.

## Conclusion

Increasing the level of fire protection in warehouse transshipment logistics complexes requires an integrated and systematic approach based on a combination of regulatory regulation, technical equipment, organizational culture and the use of innovative digital solutions. Fire safety should be considered as an integral part of the sustainable management of logistics facilities, and investments in fire prevention measures should be considered as a contribution to saving people's lives, preserving property and business continuity. Only if the set of conditions discussed in this article is fulfilled, it is possible to achieve a high level of protection and meet modern security requirements.

### List of sources

1. Suvorov V.A. Risk analysis at storage and logistics facilities // Safety and Technology. 2022. №. 2. p. 35-41.
2. Technical regulations on fire safety requirements: Feder. Law №. 123-FL of July 22, 2008. Access from the ConsultantPlus legal reference system.
3. SP 484.1311500.2020. Fire protection systems. Fire alarm systems and automation of fire protection systems. Norms and rules of design // ELECTRONIC FUND of legal and regulatory-technical documentation. URL: <http://www.docs.cntd.ru> (reference date: 18.03.2025).
4. SP 485.1311500.2020. Fire protection systems. Fire extinguishing installations are automatic. Norms and rules of design // ELECTRONIC FUND of legal and regulatory-technical documentation. URL: <http://www.docs.cntd.ru> (reference date: 18.03.2025).
5. SP 486.1311500.2020. Fire protection systems. The list of buildings, structures, premises and equipment subject to protection by automatic fire extinguishing installations and fire alarm systems. Fire safety requirements // ELECTRONIC FUND of legal and regulatory-technical documentation. URL: <http://www.docs.cntd.ru> (reference date: 18.03.2025).
6. SP 7.13130.2013. Heating, ventilation and air conditioning. Fire safety requirements // ELECTRONIC FUND of legal and regulatory-technical documentation. URL: <http://www.docs.cntd.ru> (reference date: 18.03.2025).
7. On the approval of Fire Safety Regulations in the Russian Federation: Decree of the Government of the Russian Federation. Federation of September 16, 2020. № 1479. Access from the ConsultantPlus legal reference system.
8. GOST P 53325-2012. Technical means of fire protection // ELECTRONIC FUND of legal and regulatory technical documentation. URL: <http://www.docs.cntd.ru> (reference date: 18.03.2025).
9. SP 6.13130.2021. Fire protection systems. Low-voltage electrical installations. Fire safety requirements // ELECTRONIC FUND of legal and regulatory-technical documentation. URL: <http://www.docs.cntd.ru> (reference date: 18.03.2025).
10. Kuzmin A.V. Fire safety management of logistics facilities. SPb.: Piter, 2019. 256 p.

**Information about the article:** submitted for editing: 07.04.2025; accepted for publishing: 18.05.2025

### Information about authors:

**Vagin Alexander Vladimirovich**, Associate Professor of the Department of Fire Safety of Buildings and Automated Fire Extinguishing Systems of St. Petersburg University of State Fire Service of EMERCOM of Russia (196105, Saint Petersburg, Moskovskiy ave. 149), Candidate of Technical Sciences, Associate Professor, e-mail: [vagin@igps.ru](mailto:vagin@igps.ru), SPIN-code: 3296-1936

**Ragimov Anton Olegovich**, Master's student of St. Petersburg University of State Fire Service of EMERCOM of Russia (196105, Saint Petersburg, Moskovskiy ave. 149), e-mail: [antonragimov96@mail.ru](mailto:antonragimov96@mail.ru)

**Sai Anna Romanovna**, Lecturer at the Department of Supervision of St. Petersburg University of State Fire Service of EMERCOM of Russia (196105, Saint Petersburg, Moskovskiy ave. 149), e-mail: [a-novik@mail.ru](mailto:a-novik@mail.ru), SPIN-code: 3161-3187