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Editor

Komarytskyy M.L.

Ph.D. in Economics, Associate Professor

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e-mail: toronto@sci-conf.com.ua

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GENERAL INFORMATION ABOUT ALARM SYSTEMS AND FIRE ALARMS

Yakukhin Serhii

Senior teacher

Antoshkin Oleksii

Ph.D. in Engineering, Associate Professor

Bondarenko Serhii

Ph.D. in Engineering, Associate Professor

Oliinyk Volodymyr

Doctor of Engineering, Associate Professor

Derevianko Oleksandr

Ph.D. in Engineering, Associate Professor

Chykalo Vladyslav,

National University of Civil Protection of Ukraine

Kharkiv, Ukraine

Abstract: A comprehensive theoretical analysis of the current state, structure and principles of functioning of fire alarm systems (FAS) in Ukraine has been carried out based on current educational literature and the current regulatory framework. The basic architecture of the FAS has been considered and a comparative characteristic of non-address, address and address-analog systems has been given according to the criteria of accuracy of localization of the combustion center and reliability. The classification, principles of operation and specifics of the application of the main types of fire detectors have been studied in accordance with the requirements [4]. The key factors of fire protection that affect the quality of functioning of the FAS at facilities for various purposes have been identified.

Keywords: Fire alarm systems, fire detectors, fire control and monitoring device.

Ensuring fire safety of facilities for various purposes is one of the priority tasks of civil protection in Ukraine. The current stage of development of fire protection systems (FPS) is characterized by the rapid integration of digital technologies and the

transition to European safety standards.

The main tool for minimizing losses and saving lives is the fire alarm system, which provides round-the-clock monitoring of the condition of premises and ensures early detection of dangerous fire factors [1; 3]. The role of the primary link in this system is assigned to fire detectors, the overall effectiveness of the facility's protection depends on their technical perfection and correct selection [2; 4].

According to the provisions of [3], a fire alarm system is a set of technical means designed to detect a fire at an early stage, generate alarm signals for warning systems, control evacuation, and launch other fire protection systems (fire extinguishing, smoke removal).

The basic composition of any fire alarm system includes the following elements:

Fire detectors (FD) are technical means for recording changes in physical or chemical parameters of the environment that indicate the occurrence of a fire.

Fire alarm control and monitoring device (FCD) is a central element that supplies power to detectors, receives and analyzes their signals, displays the system status, and transmits commands to actuators.

Fire alarms are light, sound, or speech devices that notify people in a building of danger.

Communication lines (signal loops) are wired or radio channels that provide information exchange and power supply between system components.

According to the guidelines [5], the design of the fire alarm system should take into account the specifics of the building, architectural and planning solutions, and the potential speed of fire spread.

In domestic design and operation practice, three main types of fire alarm systems are distinguished [1; 2]:

Non-address (threshold) systems

The principle of operation is to control the parameters of the electric current (resistance) in the alarm loop. When the detector is triggered, it sharply changes its internal resistance, which is recorded by the control panel as a “Fire” signal.

Advantages: low cost of equipment, ease of commissioning.

Disadvantages: inability to determine the exact location of the activated sensor (only the general loop is determined, where there can be up to 30 sensors), high probability of false alarms.

Addressable systems

Each fire detector in such a system has its own unique digital code (address). The fire alarm control panel device cyclically polls each detector in turn, receiving data on its current state ("Normal", "Fire", "Fault").

Advantages: accurate determination of the location of the cell (with accuracy to a separate room), lower costs for cable products due to the ring structure of the loops.

Addressable analog systems

The most progressive and reliable type of fire alarm system, recommended for facilities with a high number of floors or a significant concentration of people. Unlike previous types, the decision about the presence of a fire is made not by the detector, but by the central processor of the fire alarm control panel based on the dynamics of changes in analog data [1; 4].

Advantages: flexible compensation for sensor dust, minimal level of false alarms, monitoring of system performance in each area.

Requirements for fire detectors are clearly regulated by national standards [4]. Depending on the means of reaction to the phenomenon to which they respond, the following main groups are distinguished [1; 2]:

Smoke fire detectors

They are the most common in civil engineering, since most fires in the initial stage are accompanied by the release of smoke. According to the principle of operation, they are divided into:

Opto-electronic (point): record the scattering of infrared radiation on smoke particles inside a special smoke chamber. Effective in detecting smoldering fires.

Linear: consist of a receiver and a transmitter (or reflector), between which an infrared beam passes through the entire room. Used in large spaces (hangars, atriums, warehouses).

Aspiration: perform a forced air fence through the pipeline system from the room and analyze it with a laser detector in the central unit. Have ultra-high sensitivity.

Thermal fire detectors

React to changes in ambient temperature. They are installed in rooms where the use of smoke detectors is impossible due to the specifics of technological processes. They are divided into:

Maximum – triggered when a given temperature threshold is reached.

Differential – react to the rate of temperature increase.

Maximum-differential – combine both protection mechanisms.

Flame detectors

React to optical radiation from an open flame in the ultraviolet (UV) or infrared (IR) spectrum. They have the highest response speed and are installed on objects with the circulation of flammable liquids and gases.

Manual fire detectors

Devices for forced (manual) activation of an alarm signal by a person who has detected a fire. They are installed on evacuation routes, near building exits and in stairwells at a height of about 1.2–1.5 m from the floor level [1; 3].

Analysis of the modern regulatory framework and specialized educational and methodological literature of Ukraine shows that fire alarm systems are a basic and critically important element of the complex of fire protection of facilities [2; 3]. Harmonization of national standards with European norms [4; 5] allowed to unify technical requirements for equipment and increase the reliability of its operation. This minimizes the likelihood of false alarms and guarantees timely activation of warning and protection systems. Understanding the principles of operation of modern fire and rescue systems and signal processing algorithms, which is considered in detail in the works of domestic researchers [1; 2], is a mandatory basis for high-quality training of specialists in the field of fire and civil safety, as well as for the successful application of fire and rescue systems in practice.

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