

The role of FAS in the context of raising building safety standards

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Abstract

The paper presents the role of fire alarm systems in buildings and proposes a framework for an application supporting the operation and maintenance of fire alarm systems (FAS). FAS should be properly maintained from the first day of commissioning. The state of readiness during operation should be maintained at the initial level. However, during the working time, the properties of the systems deteriorate, which is related to factors such as: failures, human activity, hidden defects, faulty assembly or external factors. FAS malfunction is a potential threat to the safety of people, property and the environment. The implication of the solution will reduce risk and improve fire protection activities in buildings. The proposed plan to maintain the efficiency of FAS will also allow for the standardization of procedures and the increase in the overall safety of property, health and life, as well as the natural environment.

Keywords: fire protection, safety standards, fire alarm system

1 Introduction

Fire safety is a key element of the basic requirements for buildings, as it is the second most important (after structural safety) among the seven requirements. In Poland in 2023, the total number of registered fires was 99,288 of which 2,3% were public utility fires, less than 1% were warehouse fires, 2,1% were production facilities, 30% were residential fires and the remaining 34,5% buildings. Despite technology, the increase in knowledge and, above all, the growing awareness of the society in the field of fire safety, the rate of fires in Poland is at a high level.

Fires, understood as an uncontrolled combustion process, in addition to flames and high temperatures, are also dangerous factors in the form of smoke and toxic gases. Fire is a risk that systematically generates the greatest damage, which is why it is necessary to take measures to minimize it, both in the context of the protection of property,

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health and life, and the natural environment. In recent years, the natural environment has become a key factor in achieving safety in general.

One of the most important issues related to the design, construction and equipping of buildings is to ensure the safety of their users during normal operation and in the event of fire. Ensuring safety in the event of a fire is mainly achieved by guaranteeing the rapid detection of the fire using fire alarm systems (FAS) solutions. The high level of risk associated with the outbreak of fires, both in the context of human health and life as well as the protection of property, requires special attention, so it was considered a good solution to develop a plan to maintain the efficiency of the FAS in order to increase fire safety in the facilities.

2 Characteristics of FAS

The proposal for the FAS maintenance plan in buildings was based mainly on Polish regulations and legal acts in the field of construction law and fire regulations.

In the Polish legislation, the entities that are obliged to use the FAS system are defined by the Regulation of the Minister of Internal Affairs and Administration of 20 June 2007 on the list of products used to ensure public safety or the protection of health and life and property, as well as the rules for issuing approval for use of these products (Journal of Laws of 2007 No. 143, item 1002) and the Regulation of the Minister of Internal Affairs and Administration of 7 June 2010 on the protection of buildings, other structures and areas (Journal of Laws of 2010 No. 109, item 719).

The obligation to apply FAS applies mainly to public facilities, where there may be a gathering of a larger number of people, e.g. a mass event. We are talking about places such as theatres with more than 300 seats, cinemas with more than 600, entertainment and sports halls over 1500, but also hospitals, with the exception of psychiatric hospitals, and sanatoriums with more than 200 beds in a building, or commercial or exhibition buildings.

The priority of FAS is to ensure effective protection of human life and health, property and the environment against the effects of a potential fire. It is implemented by detecting a fire at its earliest stage and notifying the people currently on the premises, people responsible for safety at the facility and the fire brigade unit closest to the facility about the situation. Such a system allows for the maximum reduction of the time it takes to notify the services of a potential fire, minimizing the risk of losses.

Classic FAS consists of elements such as:

- fire alarm control panel,
- remote control devices for fire protection equipment,
- consoles with microphones, manual call points,
- fire detectors.

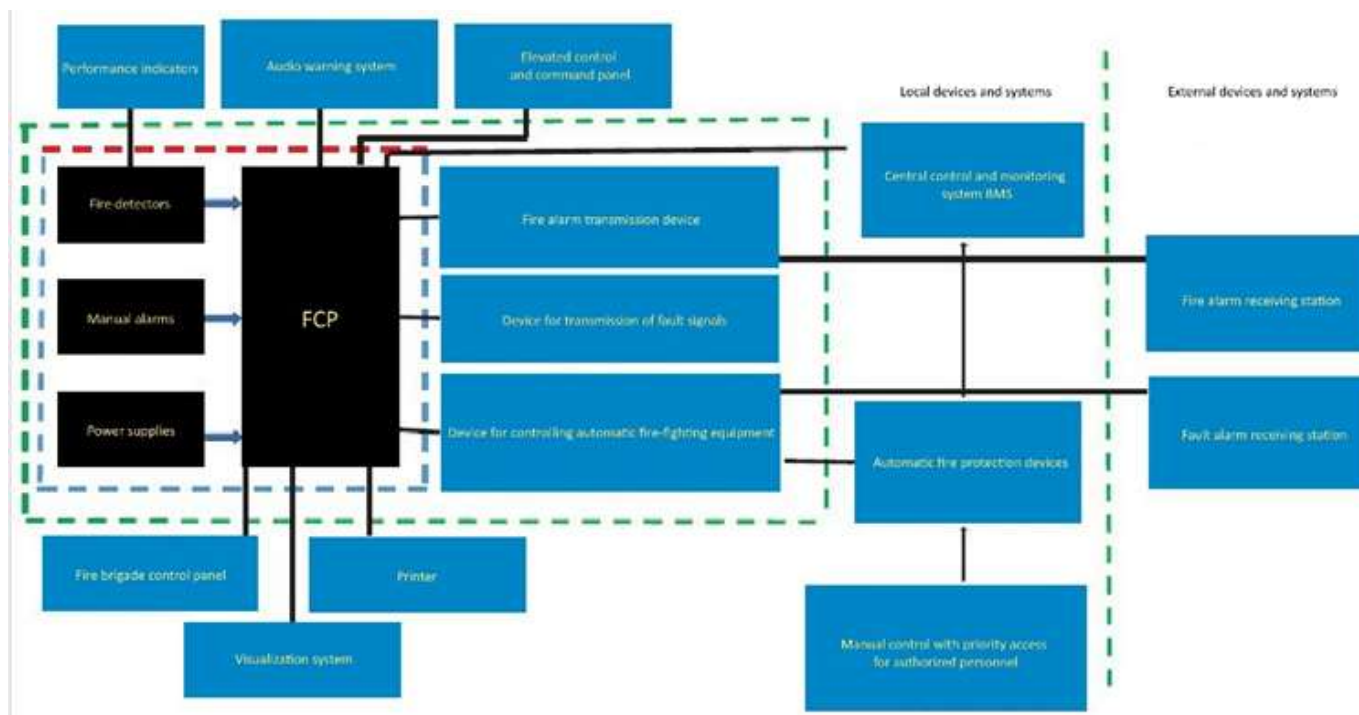


Figure 1. Diagram of classic FAS

FAS should be properly maintained from the first day of commissioning. The state of readiness during operation should be maintained at the initial level. However, during the working time, the properties of the systems deteriorate, which is related to factors such as: failures, human activity, hidden defects, faulty assembly or external factors. FAS malfunction is a potential threat to the safety of people, property and the environment

Maintenance of FAS systems in Poland is regulated by the Regulation of the Minister of Internal Affairs and Administration of 7 June 2010 on fire protection of buildings, other structures and areas (Journal of Laws of 2010 No. 109, item 719). The regulation explicitly indicates the requirements for testing and testing fire protection equipment, including:

- execution of fire protection equipment in the building in accordance with the design agreed by the fire protection expert. Before the devices are allowed to be used, it is necessary to carry out tests including tests appropriately selected for the device, confirming their correct operation;
- portable and portable fire extinguishers as well as fire-fighting equipment should be subjected to maintenance and technical inspections in accordance with the guidelines contained in the Polish Standards for fire extinguishing devices and fire extinguishers, in the technical and operational documentation and in the operating manuals developed by their manufacturers;
- the periods in which maintenance and technical inspections should be carried out are determined by the manufacturer, but they should be performed at least once a year.

Technical inspections and maintenance activities should be carried out at intervals determined by the manufacturer, but at least once a year. This requirement results from the Regulation of the Minister of Internal Affairs and Administration of 7 June 2010 on fire protection of buildings, other structures and areas. In this it is indicated that fire-fighting equipment is subject to technical inspections and maintenance activities at least once a year.

It is the responsibility of the FAS users to be generally aware of the problems occurring in the facility that will affect the proper operation of the fire detection and alarm system. Responsibility for establishing procedures for dealing with various alarms, training of persons authorized to operate the CSP, preventing false alarms, keeping a log and recording of all events, ensuring proper maintenance and service rests with various persons, from the facility manager, to those designated by the manager, or by contract with a third party, i.e., the company that installs or services the FAS.

3 Framework for the proposed solution

With many units involved, it seems reasonable to develop a coherent plan for maintaining the efficiency of the FAS and to ensure its implication in the form of a system supporting activities towards fire protection of buildings. The proposed plan for maintaining the efficiency of FAS will allow for standardization of procedures and an overall increase in safety.

It is recommended to implement the FAS maintenance plan in the form of an application or module in the implemented system in the case of enterprises (e.g. ERP). The FAS maintenance plan would then indicate to the user the need to carry out the actions along with instructions on how to carry out the procedures. Moving on to the next task would require confirmation of the completion of the indicated activities, which would significantly increase the involvement of authorized persons in the activities.

The elements of the proposed FAS maintenance plan are shown in Figure 2.

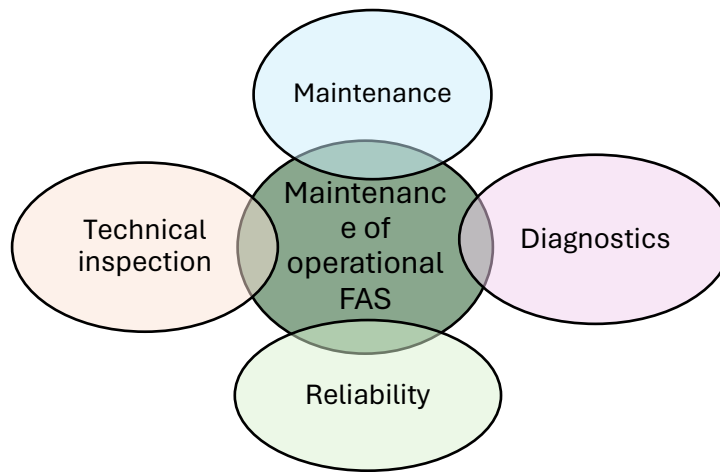


Figure 2. *Elements of the FAS Performance Maintenance Plan*

The proposed FAS maintenance plan includes 4 key elements to minimise fire safety risks, which should be closely integrated and controlled.

3.1 Key elements to minimise fire safety risks

Maintenance

The maintenance schedule includes:

- daily maintenance - focuses on verifying the fire alarm control panel whether it is in a state of supervision, whether there have been changes in the supervision status and it has been recorded, whether appropriate actions have been taken with each alarm registered since the previous day.
- monthly maintenance – control of access and Manual Call Point (MCP), event book, emergency generator sets, printing device (including control of paper, ink or ribbon stock for each printer and indicator text).
- quarterly maintenance – inspection of the control panel and other system elements according to the defects recorded in the work book in order to carry out repairs. Verify the tripping of at least one detector or MCP in each zone to verify that the control panel receives and displays specific

signals. Checking if the control panel fault monitoring is working properly, if possible causing each link to the fire brigade or remote observation centre to work properly in order to correct the operation of reports about potential fire. Carrying out tests recommended by the system manufacturer and recognizing whether there have been any structural changes in the building and its intended use, which may affect the correct placement of detectors, MCPs and other fire protection devices.

- annual maintenance - conducting tests from previous daily, monthly and quarterly maintenance. Checking each detector and oil in the facility for proper operation in accordance with the manufacturer's recommendations. Verification of the AH's suitability to activate all auxiliary functions (e.g. smoke exhaust dampers). Visually inspect the condition of all cable connections and their protections, as well as check the condition of the batteries. Reviewing the structural changes of the facility, the purpose of the rooms, which may affect the placement of detectors and manual call points. It is recommended that annual maintenance be carried out by a service company.

In the case of maintenance, the application (module) would point commands to the user according to the maintenance schedule. All actions would be directly recorded in memory, which would allow for reliable documentation of the actions taken.

Technical inspection

In accordance with the applicable Polish standards, it covers the annual maintenance of FAS detectors with the use of specialized tools such as: a test aerosol, a smoke detector tester and a telescopic pole. The test aerosol allows you to verify the efficiency of the detectors by insinuating smoke conditions thanks to the substances contained in the mixture (the composition may vary depending on the detectors being tested). The use of a test aerosol is not necessary to start a controlled fire thanks to the special gas that is compressed in the can.

The application (module) respectively one month and then two weeks before the required annual technical inspection will display a message about the upcoming deadline. In the case of a cooperating company, it will suggest sending an automated message to schedule a technical inspection.

Diagnostics

The expansion of FAS and the implication of new technologies allow for system diagnostics from the position of the system control panel or connecting to the control panel using an external device in the form of a laptop with dedicated software. The newer type of FAS control panels have a display with a control panel, through which it is possible to carry out diagnostics e.g. the level of dirt on the detectors, optical location of the detectors, testing of control panel signalling devices, testing of monitoring elements or blocking of system elements. If it is not possible to perform diagnostics from the system level, it is recommended to connect externally via software. The software allows you to verify and configure all components connected to the system. This type of connection enables diagnostics of m.in the level of setting, e.g. the sensitivity of the detectors, i.e. the speed of their reaction when smoke is detected.

The possibility of full FAS diagnostics also means the possibility of integration with the monitoring system of the State Fire Service (SFS) using an alarm transmission device (ATD). The system also allows you to connect the headquarters of a security company. If a fire alarm is activated, the security company is notified and takes appropriate action in accordance with established procedures. Their intervention can range from notifying the appropriate emergency services to taking action at the scene.

In addition to the fire alarm function, the system can also be integrated with other security systems, such as a burglary alarm system, an access control system and a monitoring system. The integration of these systems allows for comprehensive monitoring of the facility and quick response to any potential threats.

The proposed solution in the form of an application (module) would allow to send a direct message about an event (damage, malfunction, event) to authorized users of the system in the form of SMS and E-mail. Such a solution would allow for an immediate response of authorized persons, which would allow for efficient actions inside the building

Reliability

FAS systems have a continuity of power supply, which is guaranteed by a reserve battery bank, maintained in a state of charge. In the event of a failure of the main power supply at the facility, due to the inclusion of a fire protection circuit breaker or other power failure, the FAS control panel together with the actuators is in a constant state of

supervision. The capacity of the back-up battery bank shall be sufficient to keep the system in operation for at least 72 hours, after which it must be sufficient to provide alarms for at least another 30 minutes. The lifespan of batteries is in most cases 5 years from the moment they are installed, after which they must be replaced with new ones in order to maintain the proper operation of the system. The installation of FAS systems also has cabling that functions in fire conditions through fire-resistant insulation, thanks to which the system continues to function in fire conditions. Among the safety cables used in fire protection systems, there are cables with the following markings:

- PH30, PH90, E30, E90, FE180 - steam cables, installation wires and power cables.
- PH30/PH60/PH90 - the ability of the cable to maintain the continuity of the circuit (actual conduction of current or signal transmission) according to PN-EN 1363-1 expressed in minutes (test according to PN-EN 50200), respectively 30, 60 and 90 minutes.
- E30/E60/E90 - the ability of a cable together with a specific cable support structure (cable assembly) to maintain electrical functions expressed in minutes (test according to DIN 4102-12), 30, 60 and 90 minutes respectively.

The proposed application in case of reliability would indicate the state of charge of the backup battery and the state of power. In the case of a backup battery, the app would remind you to periodically check the performance of the backup battery and to replace it if it reaches the end of its useful life. A message about the need to replace the backup battery with a new one would also indicate possible methods of proper disposal of the used battery.

In addition, reliability should also be understood in the context of the reliability of FAS. False alarms in FAS are a dangerous phenomenon that has unfortunately been on the rise recently. The main reasons for this situation are faulty equipment, personnel errors, improper installation, lack of maintenance. To this end, the application also proposes to implement measures aimed at minimizing false alarms, as well as instructions on how to act in the event of their occurrence. Each occurrence of a false alarm should be recorded in the system and include its category:

- 1) alarms due to design or technical solutions, the reaction of the system is correct but it is the result of: a phenomenon similar to fire, accidental damage, improper human behaviour,
- 2) alarms due to system failure,
- 3) alarms in which a person activates the detector by, for example, lighting a cigarette, or activates a manual call point.

The total number of false alarms should refer to the maximum acceptable false alarm rate expressed by the formula:

$$MARA = \frac{n_{fa}}{n_{ad}t} \left[\frac{1}{year} \right]$$

where:

n_{fa} - number of false alarms in the facility/installation/zone

n_{ad} - number of fire detectors in the facility/installation/zone

t - period analysed; A period of 12 months = 1 year is reasonable

Based on the false positives recorded, the app would indicate the value of the MARA to the user. In the case of repeated alarms, the app should display instructions on how to reduce false alarms. It should be emphasized that the level of false alarms is considered acceptable in the case of one false alarm per hundred detectors per year.

4 Conclusions

A comprehensive fire protection system in buildings requires meeting the requirements, both in terms of the building structure itself, its technical equipment, and the adoption of appropriate procedures in the event of an emergency. In the case of public facilities and the working environment, FAS play a key role in shaping safe working conditions. Depending on the configuration, the FAS system in buildings can control passive and active fire protection elements located in the facility, such as smoke vents, fire doors or fixed fire extinguishing devices, as well

as cooperate with voice warning systems. The proposed solution can therefore be extended in terms of operations depending on the configuration in the building. A FAS maintenance plan as a consistent application can go a long way toward eliminating errors and omissions on the part of the person responsible for maintaining FAS.

The paper proposes a framework for the application of the FAS maintenance plan, which could significantly minimize the fire risk of buildings during their operation.

Bibliography