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PROBLEMS OF DIAGNOSING FIRE ALARM SYSTEMS IN TRANSPORT FACILITIES

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Abstract – The publication presents problems concerning to the implementation of the diagnosis process in the FAS with different functional structures supervising fire safety in transport facilities. The implementation of this process and the test results should be visualized at the FAC installation site (LCD panel) and sent via two independent ICT channels to the ARC. The results of diagnostic tests will enable immediate renewal of the system, and the remote service located in ARC has the ability to identify the type of inoperability and start repair using spare parts from a handy warehouse. This approach makes it possible to rationalize the value of the FAS readiness indicator in transport facilities.

Keywords – fire alarm system, operation, supervision

INTRODUCTION

The main task of electronic security systems (ESS) is to obtain reliable information about the violation of a security zone, e.g., for the intrusion detection system (IDS) or the occurrence of characteristic quantities of fire (CHQF) in a transport building for the Fire Alarm Systems (FAS), along with providing the place of occurrence of this phenomenon to the Fire Alarm Central Station (FAC), e.g., room number, line or surveillance loop number, time of change of technical condition transition from the type of operation of surveillance to alarm. All information about the detection of a fire risk is contained in the electrical sensor signals of detectors installed on lines or surveillance loops well away from the FAC. Occurring threats to fire zones are also reported by the persons using the buildings or premises in question - in the case of the FAS, this is the use of pressing the Manual Fire Alarm (MFA) or in the case of the IDS, a intrusion button. Security installations are widely used in transportation facilities, especially fire alarm systems integrated with voice alarm systems (VAS), smoke extraction systems and fixed fire extinguishing systems (FES). FES can be implemented as a water or gas (FGS) type of firefighting. According to the current decree of the Minister of Internal Affairs and Administration of June 7, 2010 on fire protection of buildings, other structures and grounds (Journal of Laws No. 109, item 719), technical fire protection measures should be understood as devices, equipment, installations and construction solutions for preventing the occurrence and spread of fires [1,2].By fire protection devices, the regulation means the following devices: fixed (FES) or semi-fixed, manually activated by MFA or self-activated, CHQF detection detectors on supervisory lines [1,3]. All of these are used to prevent, detect, and fight a fire or reduce its effects until the arrival of the State Fire Service (SFS) [2,4,5]. Using the definition in the decree of the Ministry of Internal Affairs and Administration, the FAS is a system that includes signalling and alarm devices for self-detection (detectors responding to various CHQFs - smoke, temperature, etc.) and transmission of fire and damage information through the alarm and damage signal transmission device (ADSTD) to the Fire Department and ARC (alarm receiving center) [1,6,7]. The law's requirements for individual devices and the output signals developed by the FAS according to the current standard are shown in Figure 1 [1,2].

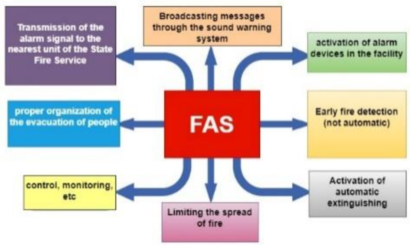

Fig. 1. Basic tasks performed by the fire alarm system [1]

According to annex 1 to Regulation (EU) No. 305/2011 of the European Parliament and of the Council of March 9, 2011, construction facilities (including transport facilities classified as critical infrastructure) as a whole and their individual parts must be fit for use in accordance with their intended use. When considering this issue, the health and safety of the people who use this property should be taken into account in particular, throughout the life cycle of these facilities. Facilities and their equipment must also meet, among other things, certain fire safety conditions in accordance with the CPR, as shown in Figure 2 [1,8,9]. According to annex 4 of this regulation, fixed fire extinguishing equipment and fire detection and signalling products are classified in a group with code 10 and were recognized as construction products. Such an approach takes into account the functions performed, relevant to safety [1,10,11]. Therefore, all components of the FAS in Poland are subject to certification carried out by the Scientific and Research Center for Fire Protection in Józefów.

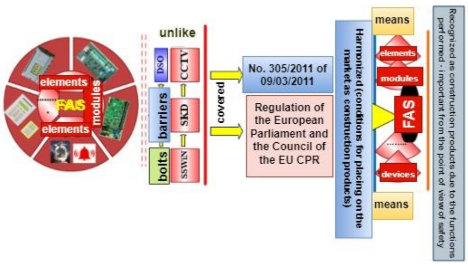

Fig. 2. Basic tasks performed by the fire alarm system [1]

I. FIRE ALARM SYSTEM USED IN FACILITIES AND EXTENSIVE TRANSPORT AREAS

FAS, due to their internal functional structure and realized technical functions of ensuring fire safety in transport facilities, can be divided into three groups:

- SSP of the focused type, with the simplest functional structure, where always the beginning and end of the supervision line or loop on which there are sensors (detectors) detecting CHQF are always located in the CSP [1,2,12,13],
- A dispersed type FAS with a complex functional structure. Such a system depending on the capacity of transport facilities expressed in m^3 or the dimensions of a wide area, has from two to dozens of FACs. The organization of such a system, the development of a fire scenario and control matrix for all elements of the FAS is very complicated. To development of the above-mentioned activities, which are necessary for the proper functioning of the FAS, dedicated computer applications are used [1,2]. FAC can be connected in a single loop, star or bus with a double transmission line (optical fiber) due to the satisfaction of certain reliability requirements for the transmission of primary information [13-15]. A dispersed system always has a master FAC and others of the slave type. But the beginning and end of the supervision loops must always be located in a single fire alarm panel,
- Mixed-type FAS is a combination of the two previously discussed functional structures of FAS systems, focused type and dispersed type. Most often, the FAS of the clustered type in such a solution implements fire protection for the most fire-prone objects - for example, fuel warehouses, power facilities associated with the supply of railroad traction, areas where railroad traffic control systems are built in, transformer and distribution stations, archives, etc.

For security reasons, transportation facilities are secured by the use of various Electronic Security Systems (ESS), and in general their purpose is to detect a threat early [2,16,17]. Figure 3 shows an extensive transportation area supervised by the ESS, consisting of two different perimeter (outer) and inner surveillance zones. This organization of safety in this area is certain requirements dictated by the safety of traffic and people. Figure 3 also shows the structure of the FAS of the focused type supervising fire safety in the facilities of energy supervision [1,8,18].

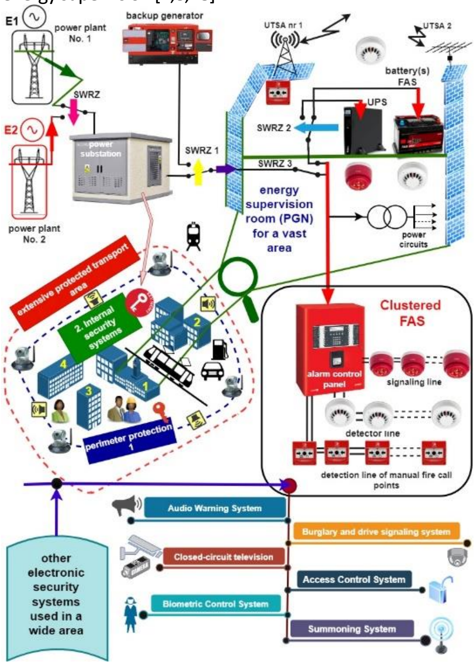

Fig. 3. Organization of ESS in a wide transport area

II. SUPERVISION PROCESS OF FIRE ALARM SYSTEM

For operational reasons, ESS should fulfil certain requirements also for supervision processes, which are specified in the Polish standard PN-93/E - 08390, in particular:

- allow precise localization of the location of an alarm in the system [1,19,20],
- trigger an alarm when the parameters of the supervisory line are deviated within the limits of $\pm 30\%$,

- self-monitor the guard lines for both current interruptions, short circuits and changes in the parameters of the guard line in the t < 1 s.,
- signal the detected damage in a time not exceeding 20 s.,
- enable performance monitoring of CP, FAC, power supplies, batteries, detectors and monitoring lines and optical-acoustic sirens (all monitoring lines should be tested separately) [1,21],
- have CP, FAC recording all events (ability to archive them) [22,23],
- have CP that will allow the system operator to receive current information about the activation/deactivation of individual zones by users, the technical status of the equipment Figure 4 [1,24,25].

From above, the standard on the ESS operation process cited the most important issues in system supervision and the functions performed by the CP.

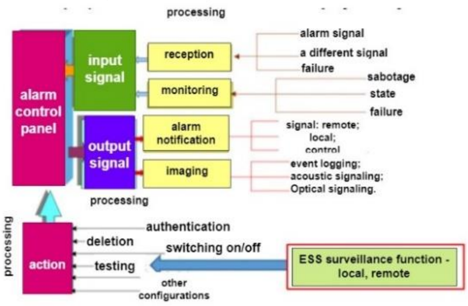

Fig. 4. Functions performed by CP in the security system

SSP systems are automatically diagnosed by the FAC at specific time intervals programmed in advance by operators and local service or located at the ARC. In this case, the process of diagnosing the FAS means knowing the future and past states, their changes over time, and the current state [2,26]. Changes in the technical states of the FAS are stored in the non-volatile memory of the FAC, and all events related to the use process can be analysed in real time. All the above-mentioned information is provided through the implementation of so-called supervision procedures, which can be carried out automatically or manually [1,5,27]. An example of parallel and sequential FAS supervision is shown in Figures 5 and 6, accordingly.

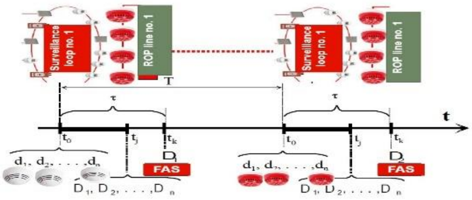

Fig. 5. Parallel supervision implemented in the FAS

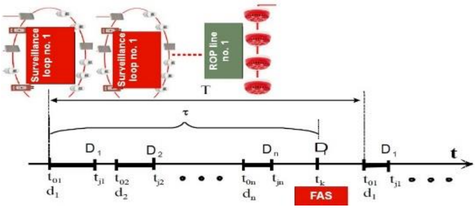

Fig. 6. Sequential metering implemented in the FAS

Figure 7 a, b shows example images of FAC LCD panels during the execution of the diagnostic process carried out in the SSP for various unfitness's. Fig. 8 shows selected diagnostic processes implemented in two different functional structures of the SSP with example times of CA response to a given unsuitability occurring in the system.

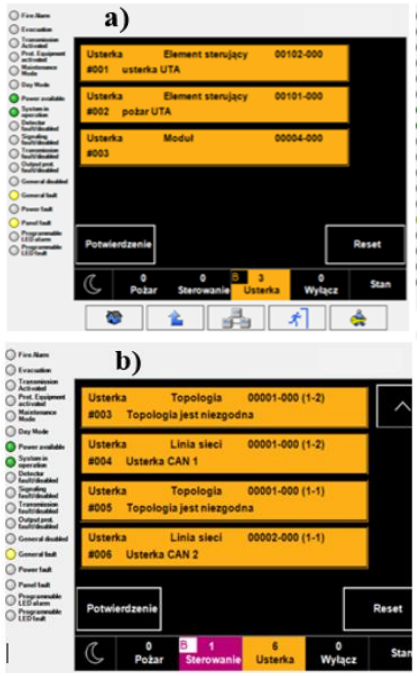

Fig. 7. a), b) sample images of FAC FAS LCD panels during the realization of the diagnosis process for various faults (visualization of the FAS LCD panel - messages in Polish)

III. Summary

The publication presents the problem of implementation of diagnostic processes in the FAS for three different structures of these systems. Due to the very important function performed by the FAS in transport facilities, the diagnostic process implemented must be reliable and performed in the shortest possible time. Imaging - the results of the implementation of the diagnostic process are presented on the LCD panel of the FAC and sent via two independent transmission lines to the ARC. Modern FAC use a microprocessor person dedicated only to the realization of the diagnostic process. The time, the period of execution of the diagnostic process is set by the people servicing the system, while the priority in the FAS is the alarm signal, which automatically interrupts the execution of the examination and conclusion. All events related to the implementation of the diagnostic process are archived and stored in the FAC memory. The execution times of the diagnostic process in the FAC are different and depend on the type of failure occurring in the system, simple events are identified in a short time, while complex failures cause the prolongation of this examination (Fig. 8.) The process of diagnosis is particularly important in FAS due to the assurance of fire safety in transportation facilities.

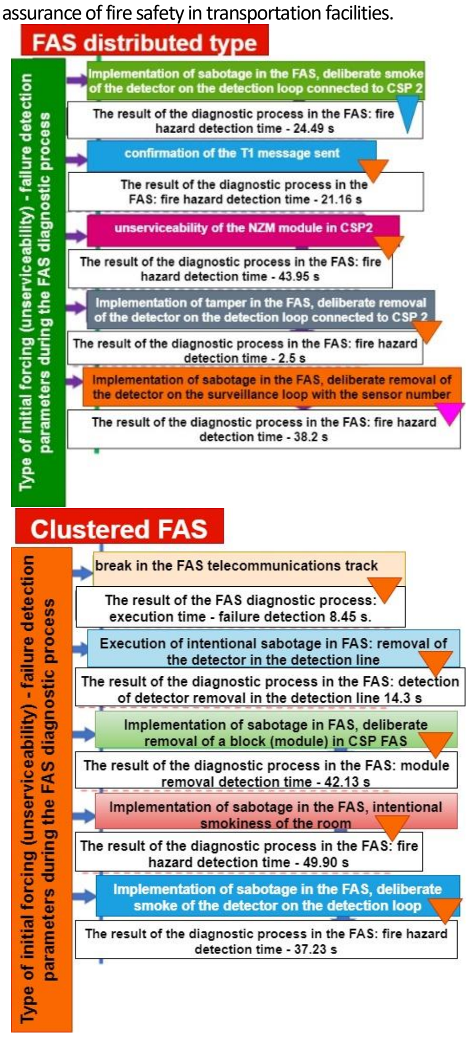

Fig. 8. Implementation of the diagnostic process in the FAS - results of tests of system response times to unfitness excitations in different supervision lines

Problemy diagnostyki systemów sygnalizacji pożarowej w obiektach transportowych

W publikacji zaprezentowano problematykę dotyczącą realizacji procesu diagnozowania w SSP o różnych strukturach funkcjonalnych nadzorujących bezpieczeństwo pożarowe w obiektach transportowych. Realizacja tego procesu oraz wyniki badań powinny być zobrazowane w miejscu zainstalowania CSP (panel LCD) oraz przesyłane dwoma niezależnymi kanałami teleinformatycznymi do ACO. Wyniki badań diagnostycznych umożliwią podjęcie natychmiastowej odnowy systemu, a serwis zdalny znajdujący się w ACO ma możliwość identyfikacji rodzaju niezdatności i podjęcia naprawy z wykorzystaniem części zapasowych z podręcznego magazynu. Takie podejście umożliwia racjonalizację wartości wskaźnika gotowości SSP w obiektach transportowych.

Słowa kluczowe: system sygnalizacji pożarowej, eksploatacja, dozorowanie

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