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## **TO THE ISSUE OF DETECTION OF SMALL UNMANNED AERIAL VEHICLES USING ACTIVE OPTICAL SYSTEMS**

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Ukraine is a nuclear state. Five nuclear power plants with fifteen operating nuclear reactors are located on its territory. The state has dozens of hydroelectric power plants and hundreds of thermal power plants, dozens of chemical, petrochemical and metallurgical plants, hundreds of railway and road bridges and other hydrotechnical and communication facilities, which are environmental protection objects of critical infrastructure. More recently, the task was only to protect these objects. Now, in the conditions of armed aggression, the task of protecting and defending these objects is not only against terrorists, but specially trained subversive-reconnaissance and subversive groups that use various means of air attack.

Existing systems of physical protection of objects protected by critical infrastructure use radar, optoelectronic, infrared, contact electronic and electromagnetic subsystems of control of the perimeter and the protected territory. The sanitary zones adjacent to the objects are controlled by these means, which in turn ensure the process of managing an emergency situation of a terrorist nature at a critical infrastructure object. The main task of this management is to prevent intruders from entering the protected object by timely detecting and stopping their actions. However, the functioning of these means of observation depends on the state of the surface layers of the atmosphere, the presence of natural and artificial obstacles and other factors.

A special difficulty in managing the safety of objects protected by critical infrastructure is the prevention of emergency situations of a terrorist nature, namely the process of detecting and identifying small-sized aerial targets. Specialists in the field of anti-terror believe that one of the dominant trends in the development of

terrorist scenarios at objects protected by the critical infrastructure of Ukraine is the use of various small manned and unmanned aerial vehicles to carry out terrorist acts.

It is necessary to narrow down the scope of considered terrorist emergency situations (ES) [1-3]. For this purpose, under protected potentially dangerous object, we mean state and non-state institutions that have a system of physical protection. When considering a terrorist emergency at a potentially dangerous protected object, it should be noted that it, like any emergency, is characterized by five stages. The first is the stage of hidden accumulation of everyday negative factors. The second stage is the process of extreme accumulation and development of negative factors, which develops into the third stage - a catastrophic event, an accident, explosion or other terrorist act [4-6]. The fourth and fifth stages are the liquidation of the consequences of a catastrophic event and distant consequences of an emergency. The last two stages are typical for any man-made accident, as, for example, an explosion at a nuclear power plant and elimination of the consequences of radioactive contamination, as well as remote consequences, will occur regardless of whether the first circuit of the power unit breaks as a result of a terrorist attack or a technological event. It should be noted that a sufficiently large number of terrorist attacks are disguised as technological failures [7-9].

Based on the results of the performed work, the following conclusions were formulated.

Analysis of emergency situations at critical infrastructure facilities, which include nuclear, thermal and hydroelectric plants, nuclear, radiation and chemically hazardous facilities, shows that they occur mainly due to the human factor. Experts in the field of anti-terror believe that the possibility of malicious intent cannot be excluded in this factor. In the conditions of hostilities on the territory of our country, it is necessary to be ready for a sudden terrorist impact on all objects of critical infrastructure of Ukraine. One of the trends in the development of terrorist scenarios at objects protected by critical infrastructure is the use of various small manned and unmanned aerial vehicles to carry out terrorist acts.

Therefore, the main task of scientific research is the prevention of emergency situations of a terrorist nature at the objects protected by the critical infrastructure of Ukraine by timely detection and identification of small unmanned aerial vehicles.

The results of all field experiments performed using a specially designed laboratory setup and theoretically calculated values of expected target detection activities as part of numerous experiments are located within the confidence intervals calculated according to the Student's criterion with a reliability of 0.99, which indicates a good convergence of the experimental results and theoretical calculations. This, in turn, confirms the reliability of the mathematical model for detecting signals reflected from small unmanned aerial vehicles using active optical systems that use the phenomena of light absorption and scattering in optically transparent media and the mathematical model for detecting and identifying small unmanned aerial vehicles using passive optoelectronic systems.

Variants of implementation of the developed models and laboratory equipment in the services of physical protection of objects protected by the critical infrastructure of

Ukraine, as well as military objects of the Ministry of Defense and the Ministry of Internal Affairs of Ukraine in the following areas are proposed. First, to optimize the security management of the protected object, first of all, detection of small air targets in proximity to the object. Secondly, to detect intruders, both on protected objects and in controlled areas around protected objects of critical infrastructure, who carry out intelligence activities. Thirdly, for timely planning and effective implementation of operational measures to prevent terrorist acts and other illegal measures at various stages of their preparation and implementation. Fourth, for the development and creation of fundamentally new (intelligent) systems of protection and protection of objects.

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