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FEATURES OF THE USE OF UNMANNED AIRCRAFT IN RADIATION ACCIDENTS

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The scale, nature and composition of emissions of polluting substances into the atmosphere can be different, both minor, local in nature, and global, with catastrophic consequences, for example, in the event of an accident at the Chernobyl nuclear power plant. The ability of different layers of atmospheric air to move at high speed in different directions leads to the risk of contamination of large areas with harmful and toxic substances, which requires operational tropospheric control to determine the conditions for liquidating the emergency situation and the need to evacuate the population from the contaminated area [1].

In the work [2,3], an analysis of the use for the purposes of atmospheric air monitoring of converted civil aircraft: ultralight and light-engined, as well as class 3 and 4 aircraft is given. It is shown that during the elimination of accidents at the Mayak Plant in 1957, at the Chernobyl Nuclear Power Plant in 1986, at the Siberian Chemical Plant in 1993, and at the Fukushima-1 NPP in 2011, the most effective means of obtaining operational information about the state of atmospheric pollution turned out to be a set of devices (dosimetric and gas analytical) installed on the aircraft. For example, during the elimination of the accident at the Chernobyl nuclear power plant, full atmospheric and radiation monitoring (including aerosol sampling) was started a day after the accident with the help of the An-24rr laboratory aircraft (radiation scout), after which such flights became regular.

The main disadvantages of using converted civilian aircraft (as a rule: ultralight, light engine, 3 and 4 classes) as an atmospheric radiation laboratory – scout are: high cost of production and operation, lack of technical ability to maintain a static position in the atmosphere during measurements and the possibility of significant radiation exposure of pilots.

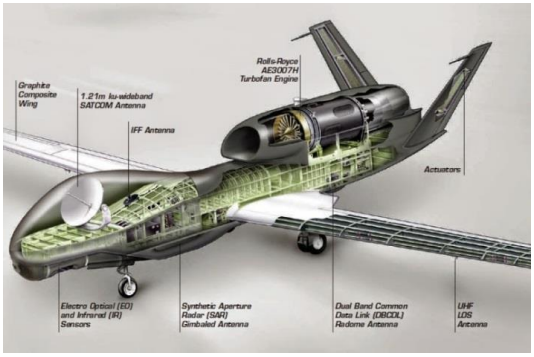

Figure 1 - UAV Global Hawk

In work [4], an analysis of the use for the purposes of atmospheric and radiation control, photography and video surveillance of helicopters of the Self-Defense Forces of

Japan, as well as a large American military intelligence – Global Hawk (Fig. 1) during the liquidation of the accident at the Fukushima-1 NPP.

Global The Hawk is an autonomous jet unmanned aerial vehicle (UAV) with a sensor suite that includes synthetic aperture, electro-optical and infrared sensors with telescopic capabilities for high-resolution imaging. Infrared sensors took pictures in the damaged parts of the nuclear power plant. He helped Japanese specialists collect real-time images of the destruction at Fukushima-1, which made it possible to speed up the elimination of the disaster.

Taking into account the experience of the liquidation of the accident at the Fukushima-1 NPP, the existing and developed new hardware and software complexes for monitoring radioactive pollution based on the IL-114-100 laboratory aircraft were improved at the TAIPHUN NPO [5].

The main disadvantages of using military reconnaissance aircraft, such as Global, to monitor the state of atmospheric air Hawk , Mirage F.1CR, etc. [6] as well as special geophysical aircraft, such as DLR G550, HALO weather reconnaissance, M-55 GEOPHYSICS, etc., are: high cost of manufacturing and operation, lack of technical ability to maintain a static position in the atmosphere during measurements, as well as significant distance from the object when taking measurements.

The studies conducted in [7, 8] indicate the high efficiency of using small UAVs with means of monitoring the state of the atmosphere to determine the level of pollutants in atmospheric air.

Increasing efficiency and miniaturization of management and control systems gave a significant impetus to the development of unmanned aviation, small unmanned aerial vehicles (UAVs) – airplanes, helicopters, copters with three or more propellers - became widespread.

The presence of light and compact high-resolution photo-video cameras installed on the UAV "Air Photo Service" , made it possible to make a map of the destruction at the Fukushima-1 NPP on March 11, 2011. The use of small UAVs capable of hovering in space made it possible to determine the real situation at various points at the Fukushima-1 NPP and the area adjacent to it and improve the safety of restoration work. That is why Japan purchased three helicopter – type UAVs from the French company Helipse and four complexes of the RQ-16 T-Hawk type (Fig. 3) from the Honeywell (USA) company.

The T-Hawk UAV, weighing about 8 kg with a tunnel fan and the ability to take off and land vertically, can operate for up to 40 minutes at a distance of up to 10 km from the control point. Equipped with a gasoline two-cylinder two-stroke engine with a capacity of 4 hp, it has the function of remote guidance and image magnification, which allowed the pilots to study the damaged areas of the reactor in detail and transmit data to emergency services employees in real time. The use of direct video data transmission made it possible to adjust the T-Hawk's flight course according to the most difficult areas of the damaged reactors. The pilots, in turn, could control the video cameras of the aircraft, setting the required viewing angles for the most clear display of the damaged equipment.

All four T-Hawk UAVs operating at the Fukushima-1 NPP were equipped with equipment for measuring the level of radiation and assessing the state of the atmospheric air, data were obtained on the radiation background and the presence of impurities in the air at different altitudes. While flying over the reactor of the 1st unit of the Fukushima-1 nuclear power plant, two T-Hawks lost control and exploded on the roof of the reactor, the reason for the loss of control was not provided by Honeywell (USA).

Currently, the level of radiation and the state of the atmospheric air at the Fukushima-1 nuclear power plant are monitored with the help of special UAVs developed by the IAEA. These UAVs have a rounded shape (Fig. 4) and are powered by six electric motors (sexticopter), and are also equipped with built-in cameras, several dosimeters, gas analyzers and can fly completely autonomously.

The main disadvantage of small UAVs when using them as means of atmospheric and radiation control is the short time of operation in the zone of local pollution, therefore, monitoring flights must be organized and conducted according to a predetermined method, with the determination of the time and routes of UAV tracking.

Figure 3 – T-Hawk UAV

Figure 4 – Sexticopter of the IAEA

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