On Some Measures to Ensure Nuclear Safety During Utilization of Aircrafts and Helicopters

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Abstract

The Article discussing the situation for application of radioactive materials in flight appraises. They purpose for their utilization are quite different. An article describes some widely used cases focusing the attention ion the requirements to be met for ensuring of nuclear safety and radiation protection. Same can be said for storing of aircraft parts containing radioactive materials. Especial attention should be paid when aircraft become exhaust and removed from the operation, when radioactive materials should be managed as radioactive waste. Another case refers to accidents involving radioactive materials requiring implementation standards for radiological emergency situation

Key words: nuclear safety, nuclear security, radioactive waste, exemption level, depleted Uranium

As it is known some types of aircrafts and helicopters have different parts containing radaioacative substances. For instance, clock faces of a number of measuring equipment are covered by ^{226}Ra. All these surfaces are protected by glass to prevent direct contact with radioactive substance, but no shielding is applied for ionization radiation. The purpose of using of ^{226}Ra is its luminescence property allowing to identify the numbers on the surface even in darkness without additional lighting. At the same time radiation beam has negative influence on the health of the pilots sitting near the surface, therefore the using of sources of ionization radiation should be justified as required by international standards [1,2] and national Georgian legislation [3,4]. It means that the profit from the using of the radiation should exceeded the harm. Meantime it also should be considered that radiation level for such devices are low – even in some cases the nuclide concentration meets the exemption requirements [4,5], but in many cases the exemption level is exceeded (especially for Soviet production aircrafts). When the source activity exceeds the adopted exemption level, the special regulations should be applied for using of radioactive source as defined by the Georgian legal acts. After the ending of the operation period, the clock face becomes radioactive waste, which also requires defined treatment [6-9]. The concentration of radionuclide is very low, but considering its long half-life (1600 years) of ^{226}Ra , the waste can be assessed as LLW [4,10]. Unfortunately, Georgia is still developing its capacity for radioactive waste treatment, therefore such waste should be safely stored at the

storage facility, when especial attention should be paid not only for the source shielding, but also for possible leakage of radionuclide. Another subject related to these clock faces is their inventory. Usually these parts are not marked with radiation signs, therefore strong control on their use and father treatment should be established including keeping inventory for tracing the situation with radioactive substances.

Another case for radionuclides application in flight apparatuses is freezing control devices using for measuring of ice thickness on the surface of the flight apparatus. Many former soviet construction aircraft, like АН-24/26 has freezing control device РИО-3 containing radionuclide $^{90}Sr/^{90}Y$ (with initial activity is 999 GBq) (Fig.1).

Fig.1 general view of ice thickness control device

The half-life of the parent radionuclide ^{90}Sr is 29 years. The nuclide by betta decay transforms to ^{90}Y, which also characterized by beta decay (half-life 64 hours). It should be emphasized that radionuclide has only "pure" beta decay and produces gamma rays only due to braking radiation, which makes impossible to assess the nuclide activity or even identify it by gamma spectroscopy. Although the source belongs to the fourth category (its activity is near the border of the third activity group) [11], it is not proper utilization can cause the serious damage to human health. Such type control devices are also used on МИ-2 and МИ-8 helicopter. The principle used in the devices is very simple – beta flux is absorbed by generated lay of ice. The absorption is depends on the thickness of ice. This phenomena allows to use such control device for effective measurement of ice thickness on the surface of the aircraft.

Especial attention should be paid not only to ensuring of safety during the operation of the device, but also to ensuring of safety during the storing of spare parts. Usually on the territory of airports

the special ware houses are arranged to store all necessary parts for aircraft. The storing of freezing control devices containing of radioactive sources requires especial attention and measures such as establishing of control and supervise areas, providing of radiological monitoring of workplace and individual doses, applying of experienced personnel and establishing all necessary measures for radiation protection as considered by issuing authorization.. Another issue is nuclear security, which measure should apply for warehouse (storage), where radioactive sources are kept [12]. It is very important to prevent any intrusion and illegal using of radioactive sources, including terroristic purposes (for instance such as production of s.c. dirty bombs).

Another case of using of radioactive materials in flight apparatuses refers to the depleted Uranium (DU). Usually DU contains very low concentration of ^{235}U (less than 0.719%), which prevents its using as a nuclear material. At the same time Uranium is characterized with high density (the density of Uranium is two times beiger than density of lead). Uranium is used in the aircrafts especially for this purpose. For instance, Boeing- 747 contains DU with weight of 1 500 kg used to keep the balance. It should be emphasized, that DU is widely used also different areas of human activity. For instance DU is used as shielding material for high power radioactive sources in radiotherapy and as part of projectiles and rockets in weapon industry. It should be considered that radiation level of DU is quiet low and could not cause serious damage to human health, but at the same time in case of dispersion of DU and consequence inhalation, DU could provoke serious harm to human health.

Conclusion

1. Utilization of radioactive substance in flight apparatuses requires implementation of some measure to ensure nuclear safety and radiation protection. Especial measure also should be applied for storing of spare parts containing of radioactive substances.
2. After removing from the operation of the flight aperture using the radioactive substance a, the special activity should be conducted to dismantle the device containing radioactive substances and managing it as radioactive waste
3. If aircraft uses radioactive material, in case of accident (especial aircraft crash), response on the accident and mitigation of its consequences should be conducted considering requirements for response on nuclear emergency or radiological accident.

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რადიაციული უსაფრთხოების უზრუნველყოფის ღონისძიებები თვითმფრინავებისა და შვეულმფრენების პოსტექსპლუატაციის პერიოდში

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საკვანძო სიტყვები: ბირთვული უსაფრთხოება, რადიოაქტიური ნარჩენები, გასუფთავების დონე, გაღარიბებული ურანი.